(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 867 279 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
30.09.1998 Bulletin 1998/40

(51) Int. Cl.[6]: **B41F 7/02**

(21) Application number: **98105664.1**

(22) Date of filing: **27.03.1998**

(84) Designated Contracting States:
AT BE CH DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **28.03.1997 JP 95023/97**

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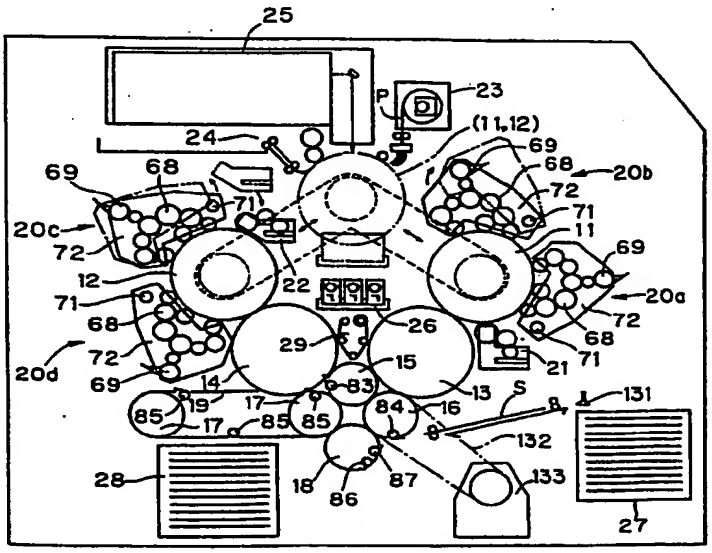
(54) Printing apparatus

(57) A printing apparatus for printing printing-papers with plates is provided with two plate cylinders (11;12), two blanket cylinders (13;14) coming into contact with the plate cylinders respectively, one impression cylinder (15) coming into contact with these blanket cylinders, an image recording part (25) for recording images on the plates on a prescribed image recording position, and a mechanism (31;32) for moving the two plate cylinders between the image recording position and printing positions respectively. Thus, the image recording part and a mechanism for feeding inks to the plates can be arranged on separate positions not interfering with each other, and a space for arranging these members can be readily ensured. Further, it is possible to record images on plates held on first and second plate cylinders with a single image recording part, whereby the printing apparatus can be simplified and the cost for the overall apparatus can be suppressed.

FIG.2



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Description

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a printing apparatus for recording images on plates, making up the same and thereafter feeding inks to the plates for performing printing.

Description of the Background Art

A general printing apparatus brings a film recording a black-and-white binary image into close contact with a plate, exposes the same thereby producing the plate, and mounts the plate on the printing apparatus for executing a printing step.

On the other hand, there has recently been proposed a printing apparatus, generally called a digital printer, which can execute such prepress and printing steps therein. This digital printer employs a "computer-to-plate" system of directly scanning and exposing a plate with a laser beam modulated on the basis of an image signal or the like for forming an image on the plate.

As the prior art of such a digital printer, Heidelberg PMT Kabushiki Kaisha puts a printing apparatus called Quick Master DI46-4 on the market. Fig. 1 is a block diagram showing the outline of this printing apparatus.

The printing apparatus, which is adapted to perform printing by the offset printing system, is provided with an impression cylinder 1 which can receive four printing-papers on its outer peripheral portion and four sets of blanket cylinders 2, plate cylinders 3, ink feeders 4 and image recorders 5 arranged on the outer periphery of the impression cylinder 1 respectively. The four sets of blanket cylinders 2, plate cylinders 3, ink feeders 4 and image recorders 5 correspond to colors of cyan (C), magenta (M), yellow (Y) and black (K) respectively.

This printing apparatus delivers unrecorded plates, which are stored in the respective plate cylinders 3 in rolled states, on the outer peripheral surface of the plate cylinder 3. The printing apparatus irradiates the plates with modulated laser beams outputted from the respective image recorders 5 for forming images on the plates, thereby making up the plates.

Then, the respective ink feeders 4 feed inks on the made-up plates. The printing apparatus mounts four printing- papers fed from a feed part 6 on the outer peripheral portion of the impression cylinder 1. The impression cylinder 1, the blanket cylinders 2 and the plate cylinders 3 rotate in a state coming into contact with each other, for successively transferring the inks from the plates to the printing- papers mounted on the impression cylinder 1 through the blanket cylinders 2 respectively, thereby executing four-color printing on the printing-papers. A removal mechanism 7 removes the completely printed printing- papers on a removal part 8.

While general offset printing is adapted to feed inks on plates after feeding damping water thereto, this printing apparatus employs waterless flat plates which are provided with silicone rubber layers on surfaces thereof for requiring no damping water as the plates, thereby omitting such feeding of damping water by damping water feeders.

While a general prepress step for plates is adapted to irradiate the plates with the image recorders 5 and thereafter develop the plates thereby making up the same, this printing apparatus employs plates completely made up only by irradiation with laser beams, thereby omitting development by developing devices after laser application.

The conventional printing apparatus shown in Fig. 1 makes up the plates on the impression cylinder 3. Therefore, the image recorders 5 must be arranged around the plate cylinders 3, in addition to the blanket cylinders 2 and the ink feeders 4. Thus, it is difficult to ensure a sufficient space for arranging these members.

In particular, the printing apparatus shown in Fig. 1 employs the waterless flat plates completely made up only by irradiation with laser beams, thereby omitting damping water feeders and developing devices. In case of employing general plates, however, the printing apparatus must use such damping water feeders and developing devices. Therefore, damping water feeders and developing devices must be arranged around the plate cylinders 3 in addition to the aforementioned blanket cylinders 2, ink feeders 4 and image recorders 5, while it is substantially impossible to arrange these members around the plate cylinders 3.

In case of arranging feeders for feeding plates to the plate cylinders 3 or removal devices for removing the plates around the plate cylinders 3, further, the printing apparatus requires a further sufficient space.

In the conventional printing apparatus shown in Fig. 1, the image recorders 5 must be arranged on positions opposite to the plate cylinders 3 for forming images on the plates mounted on the plurality of plate cylinders 3 respectively. Thus, the printing apparatus requires a plurality of image recorders 5, and hence not only the apparatus is complicated but also the cost of the overall apparatus is increased.

SUMMARY OF THE INVENTION

The present invention is directed to a printing apparatus for printing printing-papers with at least one plate. According to the present invention, the printing apparatus comprises: a) a plate cylinder holding a plate; b) an image recorder recording an image to the plate held by the plate cylinder; and c) a moving mechanism moving the plate cylinder between printing place for printing a printing-paper and image recording place for recording an image on the plate.

The image recorder and other means for printing

can be arranged on separate positions not interfering with each other. Thus, a space for arranging these elements can be readily ensured, for improving the degree of freedom of arrangement relation.

In an aspect of the invention, the printing apparatus comprising: a) a first plate cylinder holding a first plate; b) a second plate cylinder holding a second plate; c) an image recorder recording an image on a plate placed in image recording place; d) a first moving mechanism for moving the first plate cylinder between the image recording place and first printing place for printing a printing-paper; and e) a second moving mechanism moving the second plate cylinder between the image recording place and second printing place for printing a printing-paper.

The image recorder and other means for printing can be arranged on separate positions not interfering with each other. Thus, a space for arranging these elements can be readily ensured, for improving the degree of freedom of arrangement relation. Further, images can be recorded on plates held on the first and second plate cylinders with single image recorder, whereby the printing apparatus can be simplified and the cost for the overall apparatus can be suppressed.

In another aspect of the present invention, the first moving mechanism moves the first plate cylinder to the image recording place while the second plate cylinder is located in the second printing place, and the second moving mechanism moves the second plate cylinder to the image recording place while the first plate cylinder is located in the first printing place.

The prepress operation and the printing step can be executed in parallel with each other, and these operations can be completed in a short time. Thus, the use efficiency of the printing apparatus can be improved.

The present invention is also directed to a printing method of printing printing-papers with plates.

An object of the present invention is to provide a printing apparatus which can improve the degree of freedom in arrangement relation.

Another object of the present invention is to provide a printing apparatus which can record images on plates held on a plurality of plate cylinders with a single image recorder.

The foregoing and other objects, features, aspects and advantages of the present invention will become more apparent from the following detailed description of the present invention when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram schematically showing a conventional printing apparatus.

Fig. 2 is a schematic side sectional view showing a printing apparatus according to the present invention;

Fig. 3 is a plan view showing first and second plate cylinder moving mechanisms 31 and 32;

Fig. 4 is a side sectional view of the first plate cylinder moving mechanism 31;

Fig. 5 is a schematic side elevational view showing a first or second plate cylinder 11 or 12 moving to an image recording position with a feed part 23 and a removal part 24;

Figs. 6A and 6B are explanatory diagrams showing arrangement of image areas on plates P respectively;

Fig. 7 is a schematic diagram showing the first or second plate cylinder 11 or 12 moving to the image recording position with the feed part 23 and the removal part 24;

Fig. 8 is a perspective view showing the structure of an image recorder 25;

Fig. 9 is a schematic diagram showing a swing mechanism for an ink feeder 20;

Fig. 10 is a plan view of cams 81 and 82;

Fig. 11 is a schematic diagram showing a contact mechanism for a first blanket cylinder 13;

Fig. 12 is a block diagram showing the principal electrical structure of the printing apparatus;

Fig. 13 is a flow chart schematically showing prepress and printing operations of the printing apparatus;

Fig. 14 is a flow chart showing the prepress step;

Figs. 15A and 15B are explanatory diagrams showing the printing operation of the printing apparatus;

Figs. 16A and 16B are explanatory diagrams showing the printing operation of the printing apparatus;

Figs. 17A and 17B are explanatory diagrams showing the printing operation of the printing apparatus;

Fig. 18 is an explanatory diagram illustrating the structure of a printing apparatus according to another embodiment of the present invention;

Fig. 19 is a flow chart schematically showing prepress and printing operations of the printing apparatus according to this embodiment; and

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Embodiments of the present invention are now described with reference to the drawings. Fig. 2 is a schematic side elevational view of a printing apparatus according to an embodiment of the present invention.

This printing apparatus is adapted to record images on unrecorded plates P which are held on first and second plate cylinders 11 and 12 and thereafter transfer inks fed to the plates P to a printing- paper S which is held on an impression cylinder 15 through first and second blanket cylinders 13 and 14 thereby performing printing.

This printing apparatus is provided with the first plate cylinder 11 which is movable between a first printing position shown by a solid line and an image recording position shown by a two-dot chain line in Fig. 2, and

the second plate cylinder 12 which is movable between a second printing position shown by a solid line in Fig. 2 and the aforementioned image recording position.

An ink feeder 20a for feeding an ink of black (K), for example, to the plate P, another ink feeder 20b for feeding an ink of magenta (M), for example, to the plate P and a damping water feeder 21 for feeding damping water to the plate P are arranged around the first plate cylinder 11 moving to the first printing position. Further, an ink feeder 20c for feeding an ink of cyan (C), for example, to the plate P, an ink feeder 20d for feeding an ink of yellow (Y), for example, to the plate P, and a damping water feeder 22 for feeding damping water to the plate P are arranged around the second plate cylinder 12 moving to the second printing position. In addition, a plate feed part 23, a plate removal part 24, an image recorder 25 and a developing device 26 are arranged around the first or second plate cylinder 11 or 12 moving to the image recording position.

The printing apparatus is further provided with the first blanket cylinder 13 capable of coming into contact with the first plate cylinder 11, the second blanket cylinder 14 capable of coming into contact with the second plate cylinder 12, the impression cylinder 15 capable of coming into contact with the first and second blanket cylinders 13 and 14 on different positions respectively, a feed cylinder 16 for transferring the printing- paper S fed from a feed part 27 to the impression cylinder 15, a pair of removal cylinders 17 provided with chains 19 extending thereon for removing the printed printing- paper S received from the impression cylinder 15 to a removal part 28, a reverse cylinder 18 for reversing the printing-paper S in double-sided printing, and a blanket scrubber 29.

The aforementioned first and second plate cylinders 11 and 12 are coupled with first and second plate cylinder moving mechanisms 31 and 32 described later respectively, and driven by the first and second plate cylinder moving mechanisms 31 and 32 to reciprocate between the first and second printing positions and the image recording position respectively.

Fig. 3 is a plan view of the first and second plate cylinder moving mechanisms 31 and 32, and Fig. 4 is a side sectional view of the first plate cylinder moving mechanism 31. The first and second plate cylinder moving mechanisms 31 and 32 have similar structures which are symmetrical to each other, and hence common members of the first and second plate cylinder moving mechanisms 31 and 32 are denoted by the same reference numerals.

The first and second plate cylinder moving mechanisms 31 and 32 have groove holes 35 provided on side plates 34, in order to move a pair of bearings 33 pivotally supporting spindles 36 of the first and second plate cylinders 11 and 12 (Fig. 3 shows only the groove holes 35, and omits the side plates 34). Slide holders 38 which are movable along guide members 37 support the bearings 33. The slide holders 38 are provided with nuts 42, which fit with ball screws 41 coupled to drive shafts of motors 39.

Therefore, the first plate cylinder 11 is driven by the motor 39, to be movable with the slide holder 38. The first plate cylinder 11 moves between the first printing position shown by solid and broken lines in Figs. 2 and 3 respectively and the image recording position shown by two-dot chain lines in Figs. 2 and 3 along the guide member 37 and the ball screw 41. Similarly, the second plate cylinder 12 is driven by the motor 39, to be movable with the slide holder 38. The second plate cylinder 12 moves between the second printing position shown by solid and broken lines in Figs. 2 and 3 respectively and the image recording position shown by two-dot chain lines in Figs. 2 and 3 along the guide member 37 and the ball screw 41.

A stopper 44 rotating about an axis 43 is arranged in the vicinity of the image recording position on each side plate 34. A pair of positioning pins 45 regulate the horizontal moving angle of the stopper 44. The bearing 33 of the first plate cylinder 11 driven by the motor 39 comes into contact with the stopper 44, whereby the first plate cylinder 11 is positioned and fixed on the image recording position. Further, the bearing 33 of the second plate cylinder 12 driven by the motor 39 comes into contact with the stopper 44, whereby the second plate cylinder 12 is positioned and fixed on the image recording position.

In addition, fixing members (not shown) for fixing the bearings 33 of the first and second plate cylinders 11 and 12 are arranged in the vicinity of the first and second printing positions on the side plates 34 respectively. These fixing members position and fix the first and second plate cylinders 11 and 12 on the first and second printing positions respectively.

The bearings 33 of the first and second plate cylinders 11 and 12 are coupled with substantially circular detent members 46 having notches in parts thereof. Further, stop members 48 are arranged on side portions of the detent members 46. These stop members 48 are driven by air cylinders 47, to move between positions for engaging with the notches of the detent members 46 and those for separating from the notches. Thus, the stop members 48 driven by the air cylinders 47 engage with the notches of the detent members 46, whereby the first and second plate cylinders 11 and 12 are located on rotational angle positions and fixed thereto.

The detent members 46 and the like are utilized for locating and fixing the first and second plate cylinders 11 and 12 on the rotational angle positions, for the following reason: When the rotational positions of the first and second plate cylinders 11 and 12 and the first and second blanket cylinders 13 and 14 are displaced from each other, this leads to a problem such as misregistration of the printing or collision of the parts. Therefore, these cylinders 11, 12, 13 and 14 must be regularly in constant positional relation to each other. In case of

recording images on the plates P which are held on the first and second plate cylinders 11 and 12 on the image recording position by the image recorder 25 described later, rotary encoders (not shown) or the like monitor the rotational angle positions of the first and second plate cylinders 11 and 12. When moving from the image recording position to the first and second printing positions, however, the first and second plate cylinders 11 and 12 may accidentally rotate to cause displacement between the rotational positions of the first and second plate cylinders 11 and 12 and the first and second blanket cylinders 13 and 14. Therefore, the detent members 46 and the like are utilized to locate and fix the first and second plate cylinders 11 and 12 on the rotational angle positions.

The first and second blanket cylinders 13 and 14 are connected with the first and second plate cylinders 11 and 12 moving to the first and second printing positions respectively by gears provided on end portions thereof. When the gears come into contact with each other, therefore, the stop members 48 are separated from the notches of the detent members 46 for rotating and moving the first and second plate cylinders 11 and 12, thereby fitting the gears with each other.

As hereinabove described, the plate feed part 23 and the plate removal part 24 are arranged around the first or second plate cylinder 11 or 12 moving to the image recording position. Fig. 5 is a schematic sectional view showing the first or second plate cylinder 11 or 12 moving to the image recording position with the plate feed part 23 and the plate removal part 24.

The plate feed part 23 is provided with a magazine 52 storing a long roll-shaped unrecorded plate P in a high-tight state, a guide member 55 and a guide roller 56 for guiding the forward end portion of the plate P delivered from the magazine 52 by a pair of guide rollers 53 to the surface of the first or second plate cylinder 11 and 12, and a cutter 54 for cutting the long plate p into sheet-type plates P.

Each of the first and second plate cylinders 11 and 12 is provided with a gripper 57 for gripping the forward end of the plate P fed from the plate feed part 23. This gripper 57 brings its cam follower part 58 into contact with a cam (not shown) following rotation of the first or second plate cylinder 11 and 12, thereby performing a switching operation. The first or second plate cylinder 11 or 12 moving to the image recording position comes into contact with a frictional wheel 62 which is driven by a motor 61 to rotate on its surface, and is driven by the motor 61 to rotate at a low speed.

The plate removal part 24 has a pawl 63 for separating the plate P held on the first or second plate cylinder 11 or 12 after completion of printing, and transport rollers 65 and guide members 66 for guiding the plate P separated due to the action of the pawl 63 to a removal tray 64.

The gripper 57 grips the forward end portion of the plate P delivered from the magazine 52 by the pair of guide rollers 53, for winding the plate P on the outer peripheral portion of the first or second plate 11 or 12 following its rotation. A suction device (not shown) provided on the outer peripheral portion of the first or second plate cylinder 11 or 12 sucks and holds the rear end portion of the plate P which is cut by the cutter 54. In this state, the motor 61 drives the first or second plate cylinder 11 or 12 to rotate at a low speed, so that the image recorder 25 irradiates the surface of the plate P held on the outer peripheral portion of the first or second plate cylinder 11 or 12 with a modulated laser beam as described later in detail, for recording the image thereon.

The image recorder 25 records image areas 67a and 67b for performing printing with black and magenta inks respectively on the plate P mounted on the outer peripheral portion of the first plate cylinder 11, as shown in Fig. 6A. On the other hand, the image recorder 25 records image areas 67c and 67d for performing printing with cyan and yellow inks respectively on the plate P mounted on the outer peripheral portion of the second plate cylinder 12, as shown in Fig. 6B. The image areas 67a and 67b are recorded on uniformly split positions, i.e., positions separated from each other by 180°, of the plate P in the state mounted on the outer peripheral portion of the first plate cylinder 11. Similarly, the image areas 67c and 67d are recorded on uniformly split positions, i.e., positions separated from each other by 180°, of the plate P in the state mounted on the second plate cylinder 12.

In the aforementioned embodiment, two image areas 67a and 67b or 67c and 67d are provided on the single plate P mounted on the outer peripheral portion of the first or second plate cylinder 11 or 12, in order to simplify the structure of the first or second plate cylinder 11 or 12. Alternatively, the first or second plate cylinder 11 or 12 may be provided with two grippers 57 for holding two plates P, as shown in Fig. 7. Also in this case, the first or second plate cylinder 11 or 12 must hold the two plates P in a uniformly split manner so that image areas recorded on each plate P are uniformly split, i.e., separated from each other by 180° .

Fig. 8 is a perspective view showing the structure of the aforementioned image recorder 25.

This image recorder 25 is adapted to scan the plate P moving in a subscanning direction due to rotation of the first or second plate cylinder 11 or 12 moving to the image recording position with a laser beam 91 in a main scanning direction. The image recorder 25 is provided with a semiconductor laser 92 emitting the laser beam 91 as a recording beam modulated on the basis of an image signal, a lens group 93 for converging the laser beam 91 emitted from the semiconductor laser 92, a polygon mirror 94 serving as a deflector, a scanning lens group 95, and a folded mirror 96. The laser beam 91 emitted from the semiconductor laser 92 is deflected by action of the polygon mirror 94 to become a scanning beam directed to the main scanning direction, and

scans the overall region of the plate P following movement of the plate P along the subscanning direction, thereby recording a desired image on the plate P.

Referring again to Fig. 2, the ink feeders 20a and 20b are arranged around the first plate cylinder 11 moving to the first printing position while the ink feeders 20c and 20d are arranged around the second plate cylinder 12 moving to the second printing position respectively, as hereinabove described. Each of these ink feeders 20a, 20b, 20c and 20d (generically referred to as "ink feeder 20") is provided with a plurality of ink rollers 68 and an inkwell 69 pivotally supported between a horizontal pair of side plates 72.

The side plate 72 of the ink feeder 20a or 20b rotate about a shaft 71 due to action of a cam 81 or 82 described later, thereby swinging the ink feeder 20a or 20b. Due to this swinging, the ink roller 68 of the ink feeder 20a or 20b come into contact with an arbitrary one of the two image areas 67a and 67b formed on the plate P held on the outer peripheral portion of the first plate cylinder 11, so that the ink can be fed to only a necessary image area. Similarly, the side plate 72 of the ink feeder 20c or 20d rotate about a shaft 71 due to action of a cam 81 or 82 described later, thereby swinging the ink feeder 20c or 20d. Due to this swinging, the ink roller 68 of the ink feeder 20c or 20d come into contact with an arbitrary one of the two image areas 67c and 67d formed on the plate P held on the outer peripheral portion of the second plate cylinder 12, so that the ink can be fed to only a necessary image area.

Fig. 9 is a schematic diagram showing a swing mechanism for the aforementioned ink feeder 20, and Fig. 10 is a plan view of the cam 81 or 82.

The cams 81 and 82, having arcuate shapes, are arranged in a positional relation separated from each other by 180° on the side surfaces of the first or second plate cylinder 11 or 12. The positional relation coincides with that of the two image areas 67a and 67b or 67c and 67d formed on the plate P.

On the other hand, a spindle 73 slidably passes through the side plates 72 of the ink feeder 20. A bearing 74 serving as a cam follower is provided on an end of the spindle 73. The axial position of the spindle 73 is displaceable through a cylinder mechanism 77 which is connected with the spindle 73 through a coupling rod 75 and an L-shaped fixture 76.

The spindle 73 axially moves in a position where the bearing 74 provided thereon is opposed to concave parts 78 (see Fig. 10) defined by the cam 81 or 82. Following the movement of the spindle 73, the bearing 74 moves between a first position shown by solid lines in Fig. 9, a second position aligned with the cam 81 with respect to the axial direction of the spindle 73, and a third position aligned with the cam 82 with respect to the axial direction of the spindle 73.

When the bearing 74 provided on the spindle 73 is arranged on the first position shown in Fig. 9, the ink rollers 68 of the ink feeder 20 regularly come into contact with the plate P, for feeding the ink to the overall regions of the two image areas 67a and 67b or 67c and 67d provided on the plate P.

When arranged on the second position, the bearing 74 provided on the spindle 73 goes up on the cam 81 following rotation of the first or second plate cylinder 11 or 12, whereby the side plates 72 rotate about the shaft 71 to swing the ink feeder 20. At this time, the cam 81 is aligned with the image area 67a or 67c, whereby the ink rollers 68 of the ink feeder 20 feed the ink only to the remaining image area 67b or 67d in the two image areas 67a and 67b or 67c and 67d provided on the plate P.

When arranged on the third position, the bearing 74 provided on the spindle 73 goes up on the cam 82 following rotation of the first or second plate cylinder 11 or 12, whereby the side plates 72 rotate about the shafts 71 to swing the ink feeder 20. At this time, the ink rollers 68 of the ink feeder 20 feed the ink only to the remaining image area 67a or 67c in the two image areas 67a and 67b or 67c and 67d provided on the plate P.

In case of performing four-color printing with the yellow, magenta, cyan and black inks, therefore, the printing apparatus arranges the bearing 74 on the third position in each of the ink feeders 20a and 20c while arranging the bearing 74 on the second position in each of the ink feeders 20b and 20d, to be capable of feeding the inks from the ink feeders 20a, 20b, 20c and 20d to the image areas 67a, 67b, 67c and 67d respectively.

In case of feeding no inks to the image areas 67a to 67d of the plates P from the ink feeders 20, driving sources (not shown) previously swing the side plates 72 about the shafts 71 in directions separating from the first and second plate cylinders 11 and 12.

Among the four ink feeders 20a, 20b, 20c and 20d, the ink feeders 20b and 20c are moved to positions shown by two-dot chain lines in Fig. 2 by driving sources (not shown), to be prevented from interfering with the first and second plate cylinders 11 and 12 during movement thereof. Similarly, the second damping water feeder 22 of the two damping water feeders 21 and 22 is moved by a driving source (not shown) to a position shown by two-dot chain lines in Fig. 2, to be prevented from interfering with the second plate cylinder 12 during its movement.

Referring again to Fig. 2, the damping water feeders 21 and 22 are adapted to feed damping water to the plate P before the same is supplied with the ink by the ink feeder 20. While the damping water feeders 21 and 22 are provided in one-to-one correspondence to the first and second plate cylinders 11 and 12, two such damping water feeders may be provided for each of the first and second plate cylinders 11 and 12. In this case, each damping water feeder feeds damping water only to a corresponding plate, similarly to the aforementioned ink feeder 20.

The aforementioned developing device 26 is arranged under the first or second plate cylinder 11 or

12 moving to the image recording position. This developing device 26 is provided with a developing part, a stabilizing part and a rinsing part, and vertically movable between a standby position shown by solid lines in Fig. 2 and a developing position shown by two-dot chain lines.

In case of developing the plate P on which the image is recorded by the image recorder 25 with the developing device 26, the developing part, the stabilizing part and the rinsing part are successively brought into contact with the plate P driven by the motor 61 shown in Fig. 5 to rotate with the first or second plate cylinder 11 or 12, thereby developing, stabilizing and rinsing the plate P. The developing device 26 may further be provided with a drying part for drying the plate P.

The first and second blanket cylinders 13 and 14 capable of coming into contact with the first and plate cylinders 11 and 12 have the same diameter as the first and second plate cylinders 11 and 12, and blankets for transferring the inks are mounted on the outer peripheral portions thereof. These first and second blanket cylinders 13 and 14 can be freely brought into contact with and separated from the first and second plate cylinders 11 and 12 and the impression cylinder 15 by a contact mechanism described later.

The fist and second blanket cylinders 13 and 14 provided with soft blankets on the outer peripheries thereof are slightly reduced in diameter when coming into contact with the first and second plate cylinders 11 and 12. The aforementioned same diameter also includes slight errors caused by such changes. Further, each of the impression cylinder 15, the feed cylinder 16, the removal cylinder 17 and the reverse cylinder 18 described later have a diameter half that of the first and second plate cylinders 11 and 12 and the first and second blanket cylinders 13 and 14. Also in this case, the diameter includes errors caused on the basis of diameter changes similar to the above.

Fig. 11 is a schematic diagram showing the contact mechanism for the first blanket cylinder 13. The contact mechanism for the second blanket cylinder 14 is similar in structure to that for the first plate cylinder 13 shown in Fig. 11.

An eccentric shaft 102 decentered from a shaft 101 rotatably supporting the first blanket cylinder 13 is serially provided on a side portion of the shaft 101. Further, an eccentric bearing 103 further decentered from the shafts 101 and 102 is provided around the eccentric shaft 102. As shown in Fig. 11, therefore, the center 104 of the shaft 101, i.e., that of the first blanket cylinder 13, the center 105 of the eccentric shaft 102 and the center 106 of the eccentric bearing 103 are arranged on different positions respectively.

Two coupling plates 111 and 112 forming a link mechanism couple fixed plates 107 and 108 fixedly provided on the eccentric shaft 102 and the eccentric bearing 103 respectively with each other. The forward end portion of a cylinder rod 114 of an air cylinder 113 is connected to the coupled portion of the two coupling plates 111 and 112. The body of the air cylinder 113 is coupled to an end of a rotary plate 116 rotating about a shaft 115. Further, another end of the rotary plate 116 is coupled with a fixed plate 118 fixedly provided on the eccentric bearing 103 through a rod 117.

Further, two coupling plates 121 and 122 forming a link mechanism couple the rotary plate 116 with a shaft 120 of an eccentric member 119. The forward end portion of a cylinder rod 124 of an air cylinder 123 fixed to the apparatus body is connected to the coupled portion of the two coupling plates 121 and 122. A worm wheel 125 connected with the eccentric member 119 fits with a worm gear 127 driven by a motor 126 to rotate.

When the cylinder rods 114 and 124 of the air cylinders 113 and 123 expand in this structure, the surface of the first blanket cylinder 13 separates from those of the first plate cylinder 11 and the impression cylinder 15 by a slight distance, as shown in Fig. 11.

When the air cylinder 113 is driven to contract the cylinder rod 114 in this state, the first blanket cylinder 13 moves toward the first plate cylinder 11 due to action of the link mechanism formed by the two coupling plates 111 and 112, to be in contact with the first plate cylinder 11.

When the air cylinder 123 is driven to contract its cylinder rod 124 in this state, the first blanket cylinder 13 moves toward the impression cylinder 15 due to action of the link mechanism formed by the two coupling plates 121 and 122, to be in contact with the impression cylinder 15. At this time, the rotary plate 116 also rotates clockwise about the shaft 115, whereby the first blanket cylinder 13 moves not only toward the impression cylinder 15 but also toward the first plate cylinder 11. Therefore, the first blanket 13 is maintained in contact with the first plate cylinder 11.

Rotation of the eccentric member 119 results in slight movement of its shaft 120. Thus, the contact pressure between the impression cylinder 15 and the first plate cylinder 11 and the first blanket cylinder 13 can be adjusted by driving the motor 126 to rotate the worm wheel 125 connected with the eccentric member 119 thereby slightly moving the shaft 120. Therefore, the printing pressure in printing with the first blanket cylinder 13 can be adjusted.

Referring again to Fig. 2, the blanket scrubber 29 arranged between the first and second blanket cylinders 13 and 14 is adapted to feed a cleaning solution to long cleaning cloth extended on a path between a delivery roll and a take-up roll through a plurality of pressure rollers for bringing the cleaning cloth into contact with the first and second blanket cylinders 13 and 14 and sliding the same, thereby cleaning the surfaces of the first and second blanket cylinders 13 and 14. The cleaning cloth may further be brought into contact with the surface of the impression cylinder 15, for cleaning the same.

The impression cylinder 15 capable of coming into contact with the first and second blanket cylinders 13

and 14 has the diameter half that of the first and second plate cylinders 11 and 12 and the first and second blanket cylinders 13 and 14, as hereinabove described. Further, the impression cylinder 15 has a gripper 83 for holding and transporting the forward end of the printing-paper S.

The feed cylinder 16 provided adjacent to the impression cylinder 15 has the same diameter as the impression cylinder 15. A gripper 84 of the feed cylinder 16 holds the forward end portions of printing- papers S which are fed one by one from the paper feed part 27 by a reciprocating suction board 131 and transports the same. The gripper 83 of the impression cylinder 15 holds the forward end of each printing- paper S held by the gripper 84 when the printing- paper S is transferred from the feed cylinder 16 to the impression cylinder 15.

The removal cylinder 17 provided adjacent to the impression cylinder 15 has the same diameter as the impression cylinder 15. The pair of chains 19 are extended on both end portions of the removal cylinder 17, and grippers 85 are arranged on three coupling members (not shown) coupling the pair of chains 19 with each other. When the impression cylinder 15 transfers the printing- paper S to the removal cylinder 17, any gripper 85 of the removal cylinder 17 holds the forward end portion of the printing- paper S held by the gripper 83 of the impression cylinder 15. This printing- paper S is transported onto the removal part 28 following movement of the chains 19, to be removed.

The reverse cylinder 18 arranged under the impression cylinder 15 has the same diameter as the impression cylinder 15. This reverse cylinder 18 has two grippers 86 and 87 for reversing the printing- paper S in case of performing double-sided printing on the printing-paper S.

Cam mechanisms (not shown) open/close the aforementioned grippers 83, 84, 85, 86 and 87 respectively.

The feed cylinder 16 is coupled to a motor 133 through a belt 132. The feed cylinder 16, the impression cylinder 15, the removal cylinder 17, the reverse cylinder 18 and the first and second blanket cylinders 13 and 14 are coupled with each other by gears provided on end portions thereof respectively. Further, the first and second blanket cylinders 13 and 14 are coupled with the first and second plate cylinders 11 and 12 moving to the first and second printing positions respectively by gears provided on end portions thereof. Thus, the motor 133 is so driven as to rotate the feed cylinder 16, the impression cylinder 15, the removal cylinder 17, the reverse cylinder 18, the first and second blanket cylinders 13 and 14 and the first and second plate cylinders 11 and 12 in synchronization with each other.

Also when the surfaces of the first and second blanket cylinders 13 and 14 are slightly separated from those of the first and second plate cylinders 11 and 12 and the impression cylinder 15 due to action of the contact mechanisms for the first and second blanket cylinders 13 and 14 shown in Fig. 11, the gears provided on the end portions of the first and second blanket cylinders 13 and 14, the first and second plate cylinders 11 and 12 and the impression cylinder 15 engage with each other in the range of teeth thereof respectively, to be capable of transmitting rotational driving force thereof.

Fig. 12 is a block diagram showing the principal electrical structure of the printing apparatus. This printing apparatus comprises a control part 140 consisting of a ROM 141 storing operation programs necessary for controlling the apparatus, a RAM 142 temporarily storing data and the like in control, and a CPU 143. The control part 140 is connected with a driving circuit 145 generating driving signals for the ink feeder 20, the image recorder 25, the developing device 26, the blanket scrubber 29, the first and second plate cylinder moving mechanisms 31 and 32, driving parts in the contact mechanisms for the first and second blanket cylinders 13 and 14 and the motor 133 through an interface 144. The printing apparatus is controlled by the control part 140, to execute prepress and printing operations described later.

The prepress and printing operations of the printing apparatus are now described. Fig. 13 is a flow chart schematically showing the prepress and printing operations of the printing apparatus. These prepress and printing operations are adapted to print each printing-paper with four color inks of yellow, magenta, cyan and black.

First, the printing apparatus executes a prepress step of recording images on the plates P and developing the same on the first and second plate cylinders 11 and 12 (step S1). The printing apparatus executes this prepress step in accordance with a subroutine including steps shown in a flow chart of Fig. 14.

First, the printing apparatus moves the first plate cylinder 11 to a prepress position shown by the two-dot chain line in Fig. 2 (step S11). The motor 39 shown in Fig. 3 is driven to move the slide holder 38 along the guide member 37, thereby moving the first plate cylinder 11.

Then, the printing apparatus supplies the plate P to the outer periphery of the first plate cylinder 11 (step S12). The gripper 57 grips the head portion of the plate P delivered from the magazine 52 by the pair of guide rollers 53 shown in Fig. 5 so that the suction device (not shown) sucks and holds the rear end portion of the plate P cut by the cutter 54, thereby feeding the plate P.

Then, the printing apparatus records an image on the plate P held on the outer periphery of the first plate cylinder 11 (step S13). The printing apparatus records the image by driving the motor 61 for rotating the first plate cylinder 11 at a low speed while applying a modulated laser beam to the plate P held on the outer periphery of the first plate cylinder 11 from the image recorder 25.

Then, the printing apparatus develops the plate P

on which the image is recorded (step S14). The printing apparatus upwardly moves the developing device 26 to the developing position shown by two-dot chain lines in Fig. 2, and thereafter successively brings the developing part, the stabilizing part and the rinsing part into contact with the first plate cylinder 11 rotated at a low speed, for performing the development.

After completion of the development, the printing apparatus moves the first plate cylinder 11 to the first printing position shown by the solid line in Fig. 2 (step S15).

Then, the printing apparatus executes the prepress step for the plate P held on the outer periphery of the second plate cylinder 12 similarly to the steps S11 to S15 (steps S16 to S20).

After completion of the prepress step on the plates P held on the outer peripheries of the first and second plate cylinders 11 and 12, the printing apparatus ends the prepress step.

Referring again to Fig. 13, the printing apparatus executes a printing step of printing the printing- papers S with the plates P mounted on the first and second plate cylinders 11 and 12 (step S2). The operation of the printing apparatus in this printing step is described later in detail.

After completion of the printing step, the printing apparatus removes the plates P used for the printing (step S3). In order to remove the plates P, the printing apparatus first moves the first plate cylinder 11 to the prepress position shown by the two-dot chain line in Fig. 2. Then, the printing apparatus drives the motor 61 shown in Fig. 5 for rotating the first plate cylinder 11 anticlockwise while separating an end portion of the plate P from the first plate cylinder 11, and guides the plate P through the transport roller 65 and the guide member 66, for removing the same on the removal tray 64. The printing apparatus returns the first plate cylinder 11 to the first printing position, and then moves the second plate cylinder 12 from the second printing position to the prepress position for executing an operation similar to the above, thereby removing the plate P held on the second plate cylinder 12 onto the removal tray 64.

After completion of the plate removal step, the printing apparatus cleans the first and second blanket cylinders 13 and 14 (step S4). The printing apparatus separates the first and second blanket cylinders 13 and 14 from the first and second plate cylinders 11 and 12 and the impression cylinder 15 by the contact mechanism shown in Fig. 11 and thereafter rotates the first and second blanket cylinders 13 and 14, in order to clean the same. In this state, the printing apparatus brings the cleaning cloth supplied with the cleaning solution in the blanket scrubber 29 into contact with the surfaces of the first and second blanket cylinders 13 and 14 and slides the same, thereby cleaning the first and second blanket cylinders 13 and 14.

After completely cleaning the first and second blanket cylinders 13 and 14, the printing apparatus confirms whether or not another printed matter is to be printed (step S5). If the determination is of YES, the printing apparatus repeats the operations at the steps S1 to S4.

If the printing operation is ended, the printing apparatus cleans the inks (step S6). The printing apparatus removes the inks adhering to the ink rollers 68 and the inkwell 69 of the ink feeder 20 and cleans the same with an ink scrubber (not shown) arranged on the ink feeder 20.

After completion of the ink cleaning step, the printing apparatus ends all steps.

The operation of the printing apparatus in the aforementioned printing step is now described. Figs. 15A to 17B are explanatory diagrams showing the printing operation of the printing apparatus.

The following printing operation is adapted to print the printing- paper S with the four color inks of yellow, magenta, cyan and black, as hereinabove described. Referring to Figs. 15A to 17B, symbol K denotes regions of the first plate cylinder 11 and the first blanket cylinder 13 employed for printing with the black ink, symbol M denotes regions of the first plate cylinder 11 and the first blanket cylinder 13 employed for printing with the magenta ink, symbol C denotes regions of the second plate cylinder 12 and the second blanket cylinder 14 employed for printing with the cyan ink, and symbol Y denotes regions of the second plate cylinder 12 and the second blanket cylinder 14 employed for printing with the yellow ink respectively, for simplifying the illustration.

It is assumed that the image areas 67a and 67b for printing with the black and magenta inks respectively are recorded on the plate P mounted on the outer peripheral portion of the first plate cylinder 11 as shown in Fig. 6A and the image areas 67c and 67d for printing with the cyan and yellow inks respectively are recorded on the plate P mounted on the outer peripheral portion of the second plate cylinder 12 as shown in Fig. 6B, in the prepress step preceding the printing step, as hereinabove described. The ink feeders 20a, 20b, 20c and 20d are supplied with the black, magenta, cyan and yellow inks respectively.

As hereinabove described, further, the bearing 74 shown in Fig. 9 is arranged on the third position in each of the ink feeders 20a and 20c, and on the second position in each of the ink feeders 20b and 20d, so that the image areas 67a, 67b, 67c and 67d of the plates P shown in Fig. 6A and 6B are supplied with the black, magenta, cyan and yellow inks from the ink feeders 20a, 20b, 20c and 20d respectively.

First, the printing apparatus brings the first and second blanket cylinders 13 and 14 into separated states arranged on positions separated from the impression cylinder 15, due to the action of the contact mechanism shown in Fig. 11. In this state, the printing apparatus rotates the first and second plate cylinders 11 and 12 and the first and second blanket cylinders 13 and 14. At this time, the impression cylinder 15, the feed cylinder 16, the removal cylinder 17 and the reverse cylinder 18

are also rotated in synchronization.

In this state, the damping water feeders 21 and 22 are brought into contact with the plates P held on the first and second plate cylinders 11 and 12 respectively. Further, each ink feeder 20 is brought into contact with only the corresponding image area of the plate P held on the first or second plate cylinder 11 or 12. Thus, the image areas 67a, 67b, 67c and 67d are supplied with the damping water, and further supplied with the black, magenta, cyan and yellow inks from the ink feeders 20a, 20b, 20c and 20d respectively. These inks are transferred to the corresponding regions of the first and second blanket cylinders 13 and 14 respectively.

The printing apparatus repeats this operation, thereby feeding the inks to the plates P mounted on the first and second plate cylinders 11 and 12 and the first and second blanket cylinders 13 and 14. The printing apparatus repetitively executes this ink feed operation until the printing step is completed.

When the plates P mounted on the first and second plate cylinders 11 and 12 and the first and second blanket cylinders 13 and 14 are completely supplied with the inks, the printing- paper S is fed to the feed cylinder 16, so that the gripper 84 of the feed cylinder 16 holds its forward end portion, as shown in Fig. 15A. The gripper 84 of the feed cylinder 16 transfers the printing- paper S to the gripper 83 of the impression cylinder 15.

When the impression cylinder 15 further rotates to move the forward end of the printing- paper S held on the outer periphery of the impression cylinder 15 to the position opposed to the first blanket cylinder 13, the contact mechanism shown in Fig. 11 brings the first blanket cylinder 13 into contact with the impression cylinder 15. In this state, the forward end portion of the printing- paper S comes into contact with an end portion of the region of the first blanket cylinder 13 employed for printing with the black ink, as shown in Fig. 15B. The black ink is transferred from the image area 67a of the plate P held on the first plate cylinder 11 to the region of the first blanket cylinder 13 employed for the printing with the black ink. Therefore, the black ink is transferred to the printing- paper S due to further rotation of the first blanket cylinder 13 and the impression cylinder 15.

When the impression cylinder 15 further rotates to move the forward end of the printing- paper S held on the outer periphery of the impression cylinder 15 to the position opposed to the second blanket cylinder 14, the contact mechanism shown in Fig. 11 brings the second blanket cylinder 14 into contact with the impression cylinder 15. In this state, the forward end portion of the printing-paper S comes into contact with an end portion of the region of the second blanket cylinder 14 employed for printing with the cyan ink, as shown in Fig. 16A. The cyan ink is transferred from the image area 67c of the plate P held on the second plate cylinder 12 to the region of the second blanket cylinder 14 employed for the printing with the cyan ink. Therefore, the cyan ink is transferred to the printing-paper S, to which the black ink is already transferred, due to further rotation of the second blanket cylinder 14 and the impression cylinder 15.

The impression cylinder 15 continuously rotates with the first and second blanket cylinders 13 and 14 in this state, whereby the printing- paper S is completely wound on the outer peripheral portion of the impression cylinder 15, as shown in Fig. 16B. The impression cylinder 15 has the diameter half that of the first and second plate cylinders 11 and 12 and the first and second blanket cylinders 13 and 14, whereby the printing- paper S which is wound on the outer peripheral portion of the impression cylinder 15 comes into contact with the region of the first blanket cylinder 13 employed for printing with the magenta ink in second rotation. The magenta ink is transferred from the image area 67b of the plate P held on the first plate cylinder 11 to the region of the first blanket cylinder 13 employed for printing with the magenta ink. Thus, the magenta ink is further transferred to the printing- paper S, to which the black and cyan inks are already transferred, due to further rotation of the first blanket cylinder 13 and the impression cylinder 15.

When the impression cylinder 15 further rotates, the printing- paper S comes into contact with an end portion of the region of the second blanket cylinder 14 employed for printing with the yellow ink. The yellow ink is transferred from the image area 67d of the plate P held on the second plate cylinder 12 to the region of the second blanket cylinder 14 employed for printing with the yellow ink. Due to further rotation of the second blanket cylinder 14 and the impression cylinder 15, therefore, the yellow ink is further transferred to the printing- paper S, to which the black, cyan and magenta inks are already transferred, for completing the four-color printing.

The gripper 83 of the impression cylinder 15 transfers the forward end portion of the printing- paper S completely printed in four colors to the gripper 85 of the removal cylinder 17, as shown in Fig. 17A. The printing-paper S to be subsequently printed is fed to the feed cylinder 16, and thereafter transferred from the gripper 84 of the feed cylinder 16 to the gripper 83 of the impression cylinder 15.

The printing- paper S completely printed in four colors is driven by the pair of chains 19 to be transported onto the removal part 28 with the gripper 85 of the removal cylinder 17, as shown in Fig. 17B.

As hereinabove described, the diameter of the impression cylinder 15 is half that of the first and second plate cylinders 11 and 12 and the first and second blanket cylinders 13 and 14, whereby the impression cylinder 15 rotates twice while the first and second plate cylinders 11 and 12 and the first and second blanket cylinders 13 and 14 rotate once. The printing- paper S held on the outer peripheral portion of the impression cylinder 15 is printed in four colors of yellow, magenta, cyan and black while the impression cylinder 15 rotates twice.

Thus, the printing apparatus can continuously execute four-color printing by feeding a new printing- paper S from the feed cylinder 16 every time the impression cylinder 15 rotates twice.

In the aforementioned printing apparatus, the impression cylinder 15 wherein the diameter is half that of the first and second plate cylinders 11 and 12 and the first and second blanket cylinders 13 and 14 is used. However, the diameter of the impression cylinder may be the diameter of the first and second plate cylinders 11 and 12 and the first and second blanket cylinders 13 and 14 times 3/2, 5/2 and so on. In other words, when N is a natural number, the diameter of the impression cylinder may be any number if it is (2N-1)/2 of the diameter of the first and second plate cylinders 11 and 12 and the first and second blanket cylinders 13 and 14.

Fig. 18 is an explanatory diagram for illustrating the structure of a printing apparatus according to such an embodiment. This figure illustrates an impression cylinder 215 as well as first and second plate cylinders 11 and 12 and first and second blanket cylinders 13 and 14, which are similar to those of the printing apparatus shown in Fig. 2, in the overall structure of the printing apparatus. The remaining structure is identical to that of the aforementioned printing apparatus shown in Fig. 2.

In this printing apparatus, the diameter of the impression cylinder 215 is 3/2 times that of the first and second plate cylinders 11 and 12 and the first and second blanket cylinders 13 and 14. Three grippers 83 are arranged on the outer peripheral portion of the impression cylinder 215 at regular intervals, to be capable of holding three printing- papers S.

In this printing apparatus, therefore, the first and second plate cylinders 11 and 12 and the first and second blanket cylinders 13 and 14 rotate three times while the impression cylinder 215 rotates twice. While the impression cylinder 215 rotates twice, the three printing-papers S held on its outer peripheral portion are printed in four colors of yellow, magenta, cyan and black. Thus, the printing apparatus can continuously execute four-color printing by feeding new three printing- papers S from a feed cylinder 16 every time the impression cylinder 215 rotates twice.

Similarly, the diameter of the impression cylinder may be 5/2 or 7/2 times that of the first and second plate cylinders 11 and 12 and the first and second blanket cylinders 13 and 14. In the former case, the first and second plate cylinders 11 and 12 and the first and second blanket cylinders 13 and 14 rotate five times while the impression cylinder rotates twice, for printing five printing- papers S held on the outer peripheral portion of the impression cylinder in four colors of yellow, magenta, cyan and black. In the latter case, on the other hand, the first and second plate cylinders 11 and 12 and the first and second blanket cylinders 13 and 14 rotate seven times while the impression cylinder rotates twice, for printing seven printing- papers S held on the outer peripheral portion of the impression cylinder in four colors of yellow, magenta, cyan and black.

When the diameter of the impression cylinder is (2N - 1)/2 times that of the first and second plate cylinders 11 and 12 and the first and second blanket cylinders 13 and 14 assuming that N represents a natural number as hereinabove described, the first and second plate cylinders 11 and 12 and the first and second blanket cylinders 13 and 14 rotate (2N - 1) times while the impression cylinder rotates twice for printing (2N - 1) printing- papers S held on the outer peripheral portion of the impression cylinder in four colors of yellow, magenta, cyan and black.

Still another embodiment of the present invention is now described. Fig. 19 is a flow chart showing the outline of prepress and printing operations according to this embodiment.

This embodiment employs the aforementioned printing apparatus shown in Fig. 2 or the like for printing each printing- paper S with two color inks. Namely, this embodiment is adapted to move either one of the first and second blanket cylinders 13 and 14 to the printing position for bringing the same into contact with the impression cylinder 15 thereby performing the printing operation, while moving the remaining blanket cylinder to the image recording position for making up the plate P held on its outer peripheral portion.

First, the printing apparatus makes up the plate P held on the outer peripheral portion of the first plate cylinder 11 (step S31). The printing apparatus executes this prepress step by moving the first plate cylinder 11 to the prepress position shown by the two-dot chain line in Fig. 2 and feeding the plate P to the outer periphery of the first plate cylinder 11, for recording an image on this plate P with the image recorder 25 and developing the same by the developing device 26, similarly to the aforementioned embodiment.

When this prepress step is completed, the printing apparatus moves the first plate cylinder 11 to the first printing position shown by the solid line in Fig. 2, while moving the second plate cylinder 12 to the image recording position shown by the two-dot chain line in Fig. 2. The printing apparatus executes a prepress step on the plate P held on the outer periphery of the second plate cylinder 12 by an operation similar to that of the step S31 (step S32).

In parallel with the prepress step for the plate P held on the outer periphery of the second plate cylinder 12, the printing apparatus executes a printing step with the plate mounted on the first plate cylinder 11 (step S37).

Namely, the printing apparatus feeds inks to the image areas 67a and 67b of the plate P shown in Fig. 6A from the ink feeders 20a and 20b respectively, similarly to the aforementioned embodiment. When the forward end of the printing- paper S held on the outer periphery of the impression cylinder 15 moves to the position opposed to the first blanket cylinder 13, the printing apparatus brings the first blanket cylinder 13 into contact with the impression cylinder 15 due to the

action of the contact mechanism shown in Fig. 11. In this state, the impression cylinder 15 rotates twice for printing the printing- paper S held on its outer peripheral portion in two colors. Then, the printing apparatus removes the printed printing- paper S from the impression cylinder 15 to the removal cylinder 17, and feeds a new printing- paper S from the feed cylinder 16 to the impression cylinder 15. The printing apparatus continuously performs two-color printing by feeding a new printing- paper S every time the impression cylinder 15 rotates twice.

When the prepress step for the plate P held on the outer peripheral portion of the second plate cylinder 12 and the printing step employing the first plate cylinder 11 are completed, the printing apparatus moves the second plate cylinder 12 to the second printing position shown by the solid line in Fig. 2, and thereafter moves the first plate cylinder 11 to the image recording position shown by the two-dot chain line in Fig. 2.

The printing apparatus executes the printing step with the plate P held on the second plate cylinder 12 on the second printing position (step S33).

Similarly to the aforementioned case of the first plate cylinder 11, the printing apparatus feeds inks to the image areas 67c and 67d of the plate P shown in Fig. 6B from the ink feeders 20c and 20d respectively. When the forward end of the printing- paper S held on the outer periphery of the impression cylinder 15 moves to the position opposed to the second blanket cylinder 14, the printing apparatus brings the second blanket cylinder 14 into contact with the impression cylinder 15 due to the action of the contact mechanism shown in Fig. 11. In this state, the impression cylinder 15 rotates twice, for performing two-color printing on the printing- paper S held on the outer peripheral portion of the impression cylinder 15. When the impression cylinder 15 rotates twice, the printing apparatus removes the completely printed printing- paper S from the impression cylinder 15 to the removal cylinder 17, and feeds a new printing-paper S from the feed cylinder 16 to the impression cylinder 15. The printing apparatus performs two-color printing by feeding a new printing- paper S from the feed cylinder 16 every time the impression cylinder 15 rotates twice.

In parallel with the printing step employing the second plate cylinder 12, the printing apparatus removes the plate P employed for the printing from the first plate cylinder 11 (step S38). The printing apparatus executes this removal step by separating an end portion of the plate P held on the first plate cylinder 11 by the pawl 63, guiding the plate P by the transport roller 65 and the guide member 66, and removing the same on the removal tray 64. The blanket scrubber 29 cleans the first blanket cylinder 13 (step S39).

The printing apparatus confirms whether or not the printing operation with the first plate cylinder 11 is ended (step S40). In case of continuously executing the printing operation with the first plate cylinder 11, the printing apparatus repeats the aforementioned steps S31, S37, S38 and S39. In case of ending the printing operation with the first plate cylinder 11, on the other hand, the printing apparatus confirms whether or not the printing operation with the second plate cylinder 12 is continuously performed. When the printing operation with the second plate cylinder 12 is continuously performed, the printing apparatus waits in this state.

When the printing step with the second plate cylinder 12 executed in parallel with the above is completed, on the other hand, the printing apparatus removes the plate P employed for the printing from the second plate cylinder 12 (step S34). The blanket scrubber 29 cleans the second blanket cylinder 14 (step S35).

The printing apparatus confirms whether or not the printing operation with the second plate cylinder 12 is ended (step S36). In case of continuously executing the printing operation with the second plate cylinder 12, the printing apparatus repeats the aforementioned steps S32, S33, S34 and S35. In case of ending the printing operation with the second plate cylinder 11, on the other hand, the printing apparatus confirms whether or not the printing operation with the first plate cylinder 11 is continuously performed. In case of continuously performing the printing operation with the first plate cylinder 11, the printing apparatus waits in this state.

When the printing operation with the first and second plate cylinders 11 and 12 is completed, the printing apparatus cleans the inks (step S41). The printing apparatus executes this ink cleaning operation by removing and cleaning the ink adhering to the ink rollers 68 and the inkwell 69 in each ink feeder 20 by an ink scrubber (not shown) arranged on each ink feeder 20.

When the ink cleaning step is ended, the printing apparatus completes all steps.

In the prepress and printing operations according to this embodiment, the printing apparatus can execute the prepress operation while performing the printing operation with either one of the first and second plate cylinders 11 and 12. Thus, the printing apparatus can execute the prepress and printing operations in a short time, to improve its use efficiency.

While each of the aforementioned embodiments is adapted to record images on the plates P held on the first and second plate cylinders 11 and 12 by the single image recorder 25 while performing printing with the plates P, the present invention is also applicable to a printing apparatus for recording an image on a plate held on a single plate cylinder and performing printing with the plate.

While the printing apparatus according to each of the aforementioned embodiments forms two image areas uniformly distributed on a single plate held on each of the first and second plate cylinders 11 and 12, each of the first and second plate cylinders 11 and 12 may alternatively hold two plates in correspondence to the image areas. Further alternatively, the first and second plate cylinders 11 and 12 and the impression cylin-

der 15 may be identical in diameter to each other, for forming a single image area on each plate.

In addition, the printing apparatus may be provided with four plate cylinders, for performing four-color printing with such first, second, third and fourth plate cylinders. In this case, the printing apparatus may be provided with a first image recorder for recording images on plates held on the outer peripheral portions of the first and second plate cylinders and a second image recorder for recording images on plates held on the outer peripheral portions of the third and fourth plate cylinders respectively. Throughout the specification, the term "single" means that a single image recorder records images on outer peripheral portions of at least two plate cylinders.

While the invention has been shown and described in detail, the foregoing description is in all aspects illustrative and not restrictive. It is therefore understood that numerous modifications and variations can be devised without departing from the scope of the invention.

Claims

1. A printing apparatus for printing printing-papers with a plate, comprising:

   a) a plate cylinder holding a plate;
   b) an image recorder recording an image to said plate held by said plate cylinder; and
   c) a moving mechanism moving said plate cylinder between printing place for printing a printing-paper and image recording place for recording an image on said plate.

2. The printing apparatus of claim 1, further comprising:

   d) at least one ink applicator applying ink to said plate held on said plate cylinder located in said printing place;
   e) a blanket cylinder contacting with said plate cylinder located in said printing place, so that said ink applied to said plate is transfered to said blanket cylinder; and
   f) an impression cylinder holding a printing-paper and impressing said printing-paper to said blanket cylinder to transfer said ink onto said printing-paper.

3. A printing apparatus for printing printing-papers with plates, comprising:

   a) a first plate cylinder holding a first plate;
   b) a second plate cylinder holding a second plate;
   c) an image recorder recording an image on a plate placed in image recording place;
   d) a first moving mechanism moving said first plate cylinder between said image recording place and first printing place for printing a printing-paper; and
   e) a second moving mechanism moving said second plate cylinder between said image recording place and second printing place for printing a printing-paper.

4. The printing apparatus of claim 3, further comprising:

   f) ink applicators applying first ink to said first plate held on said first plate cylinder, and applying second ink to said second plate held on said second plate cylinder;
   g) a first blanket cylinder contacting with said first plate cylinder located in said first printing place, so that said first ink applied to said first plate is transfered to said first blanket cylinder;
   h) a second blanket cylinder contacting with said second plate cylinder located in said second printing place, so that said second ink applied to said second plate is transfered to said second blanket cylinder; and
   i) an impression cylinder holding at least one printing-paper and impressing said at least one printing-paper to said first and second blanket cylinders to transfer said first and second ink onto said at least one printing-paper, respectively.

5. The printing apparatus of claim 4, wherein

   said first plate has two first printing areas, and said second plate has two second printing areas.

6. The printing apparatus of claim 5, wherein

   said first plate cylinder, said second plate cylinder, said first blanket cylinder, and said second blanket cylinder have a first diameter D1,
   said impression cylinder has a second diameter D2,
   said diameters D1 and D2 are selected such that an equation:

   $$D2 = \{(2N-1)/2\}D1$$

   is satisfied, where
   N is a natural number, and
   said impression cylinder holds (2N-1) printing-papers.

7. The printing apparatus of claim 6, wherein

   said ink applicators comprises:
   two first ink feeders capable of applying first

and second parts of said first ink to any of said two first printing areas; and
two second ink feeders capable of applying first and second parts of said second ink to any of said two second printing areas.

8. The printing apparatus of claim 7, wherein

one of said two first ink feeders is movable for preventing from interfering with said first plate cylinder, and one of said two second ink feeders is movable for preventing from interfering with said second plate cylinder.

9. The printing apparatus of claim 7, wherein

said first and second parts of said first ink have different colors CL1 and CL2,
said first and second parts of said second ink have different colors CL3 and CL4, each of which is different from said colors CL1 and CL2, and
said colors CL1, CL2, CL3, and CL4 are selected from the color group consisting of yellow, magenta, cyan and black.

10. The printing apparatus of claim 4, wherein

said first plate consists of two pieces each having a printing area, and
said second plate consists of two pieces each having a printing area.

11. The printing apparatus of claim 3, wherein

said first moving mechanism moves said first plate cylinder to said image recording place while said second plate cylinder is located in said second printing place, and
said second moving mechanism moves said second plate cylinder to said image recording place while said first plate cylinder is located in said first printing place.

12. A printing apparatus for printing printing-papers with plates, comprising:

a) four plate cylinders each holding a plate;
b) an image recorder recording an image on a plate placed in image recording place;
c) moving mechanisms moving each of said four plate cylinders between said image recording place and printing place for printing a printing-paper; and
d) ink application means for applying ink of yellow, magenta, cyan and black to four plates held on said four plate cylinders, respectively.

13. A printing method for printing printing-papers with a plate, comprising the steps of:

a) moving a plate cylinder in image recording place;
b) feeding a plate to said plate cylinder;
c) recording a image on said plate;
d) moving said plate cylinder to printing place;
e) applying ink to said plate; and
f) printing printing-papers with said plate.

14. The printing method of claim 13, wherein

said step f) comprises the steps of:

f-1) contacting said plate cylinder to a blanket cylinder, so that said ink is transfered to said blanket cylinder; and

f-2) impressing a printing-paper to said blanket cylinder by an impressing cylinder to transfer said ink onto said printing-paper.

15. The printing apparatus of claim 13, further comprising the step of:

g) developing said image recorded on said plate between said step c) and said step d).

16. A printing method of printing printing-papers with plates, comprising the steps of:

a) moving a first plate cylinder in image recording place;
b) feeding a first plate to said first plate cylinder;
c) recording a first image on said first plate;
d) moving said first plate cylinder to first printing place;
e) moving a second plate cylinder in image recording place;
f) feeding a second plate to said second plate cylinder;
g) recording a second image on said second plate;
h) moving said second plate cylinder to second printing place;
i) applying ink to said first and second plates; and
j) printing printing-papers with said first and second plates.

17. A printing method of printing printing-papers with plates, comprising the steps of:

a) moving a first plate cylinder in image recording place;

b) feeding a first plate to said first plate cylinder;
c) recording a first image on said first plate;
d) moving said first plate cylinder to first printing place;
e) applying first ink to said first plate;
f) printing printing-papers with said first plate;
g) moving a second plate cylinder in said image recording place;
h) feeding a second plate to said second plate cylinder;
i) recording a second image on said second plate;
j) moving said second plate cylinder to second printing place;
k) applying second ink to said second plate; and
l) printing printing-papers with said second plate,
wherein

at least one step of said steps g) to k) are performed during said step e) to f).

FIG.1 (BAKGROUND ART)

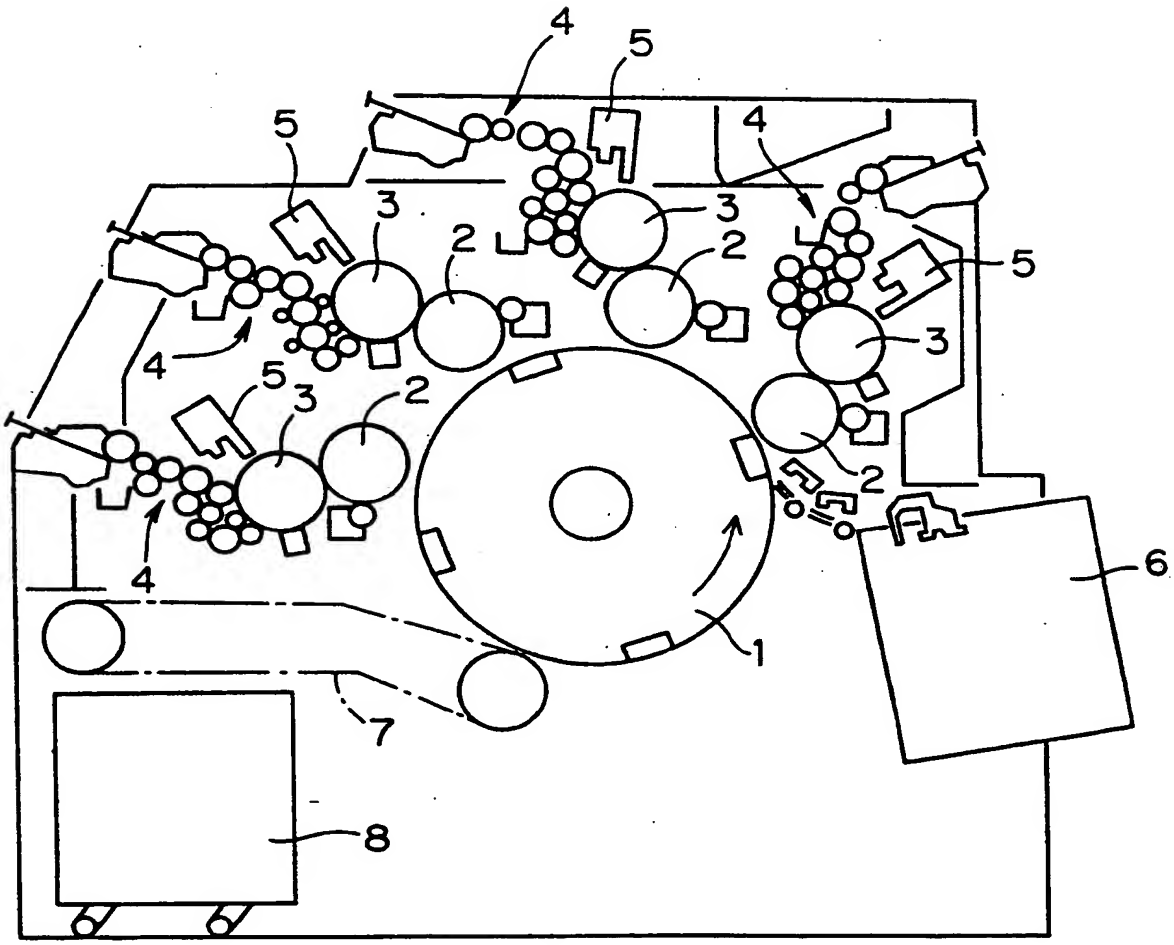
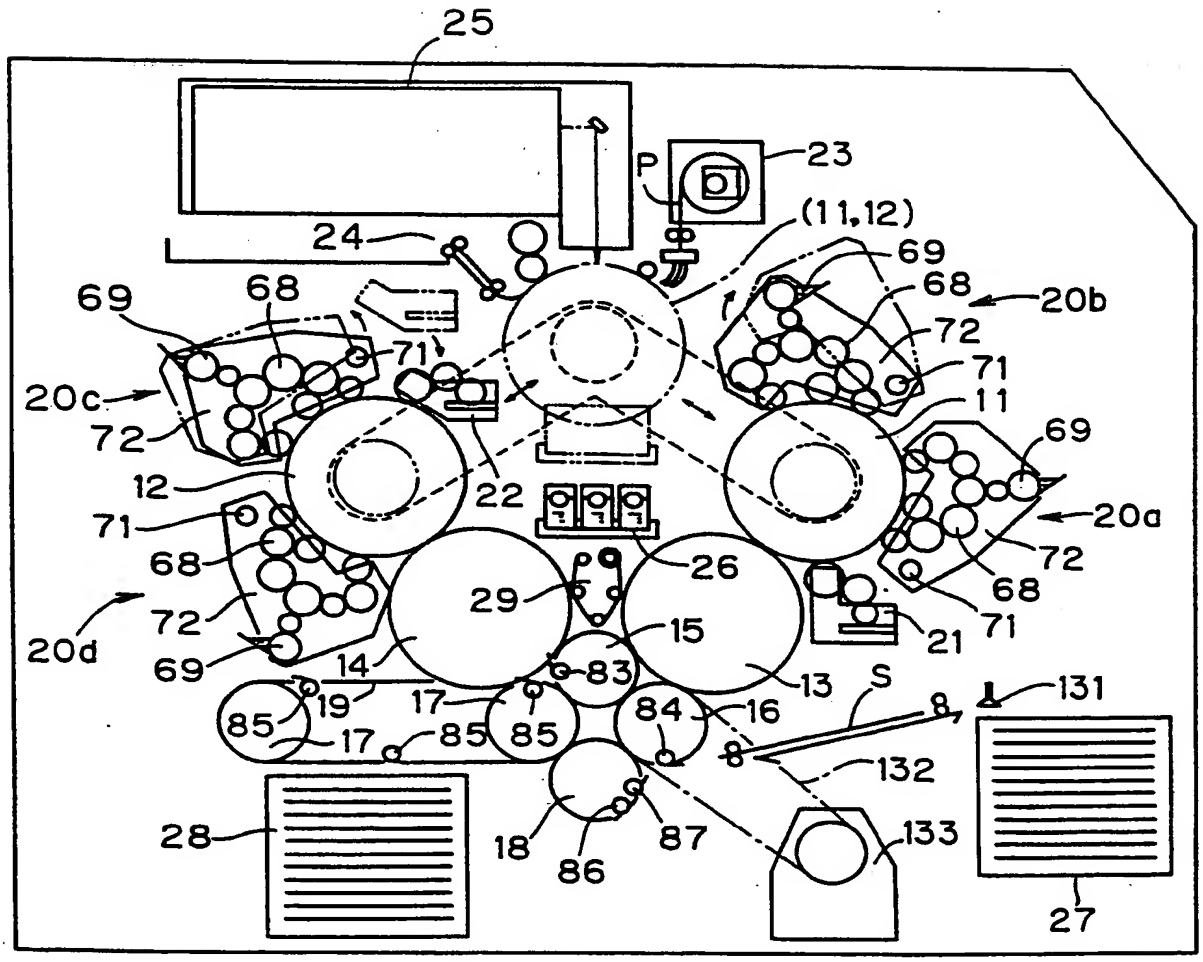


FIG.2



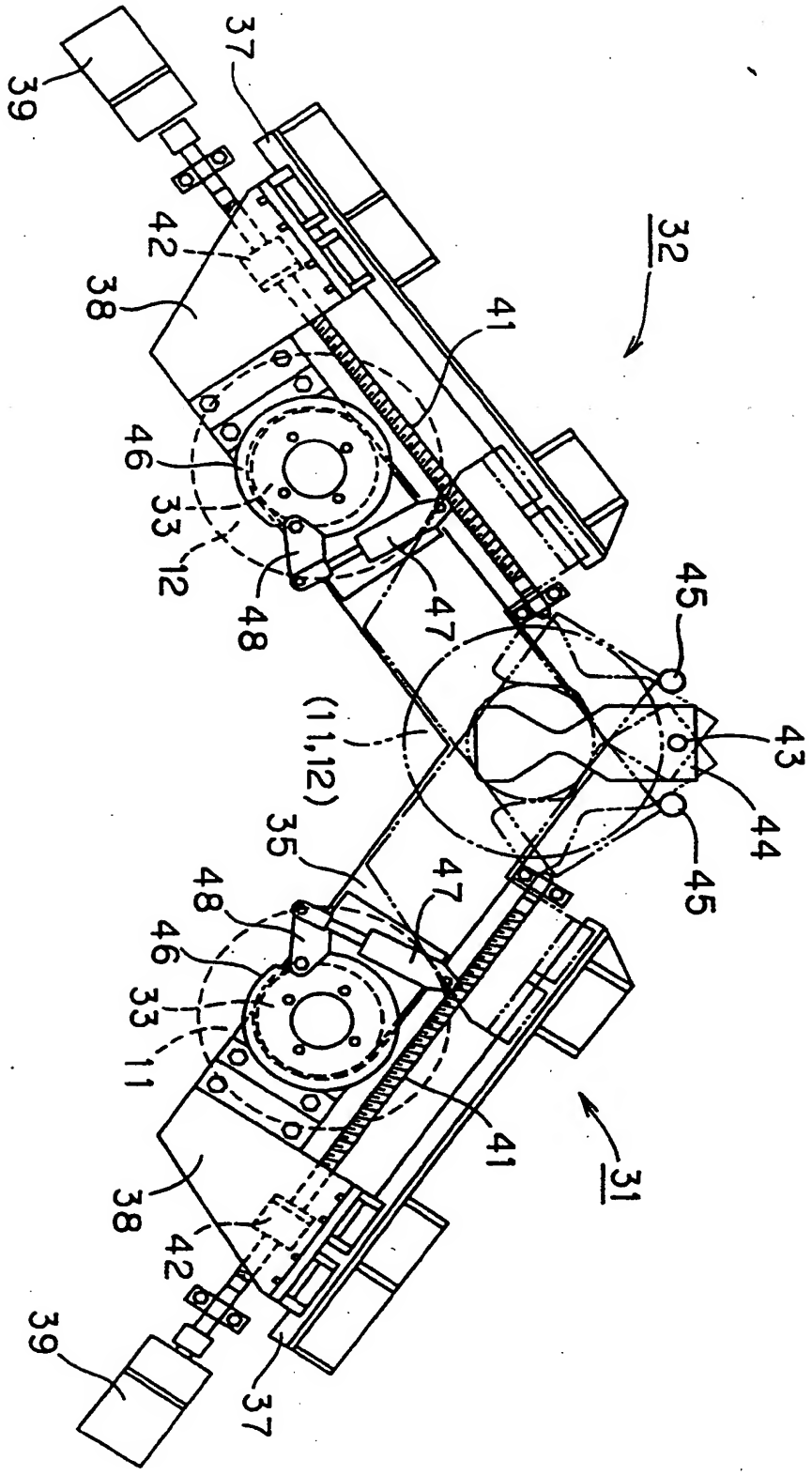


FIG.3

FIG. 4

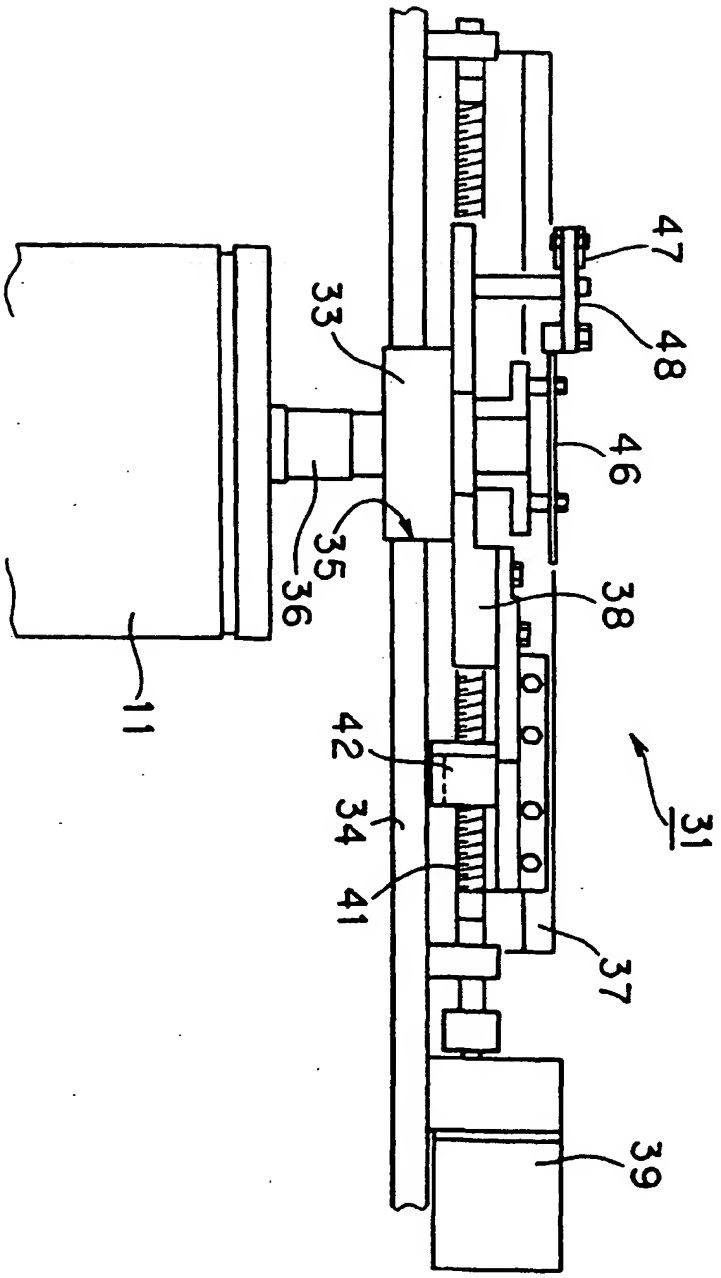


FIG.5

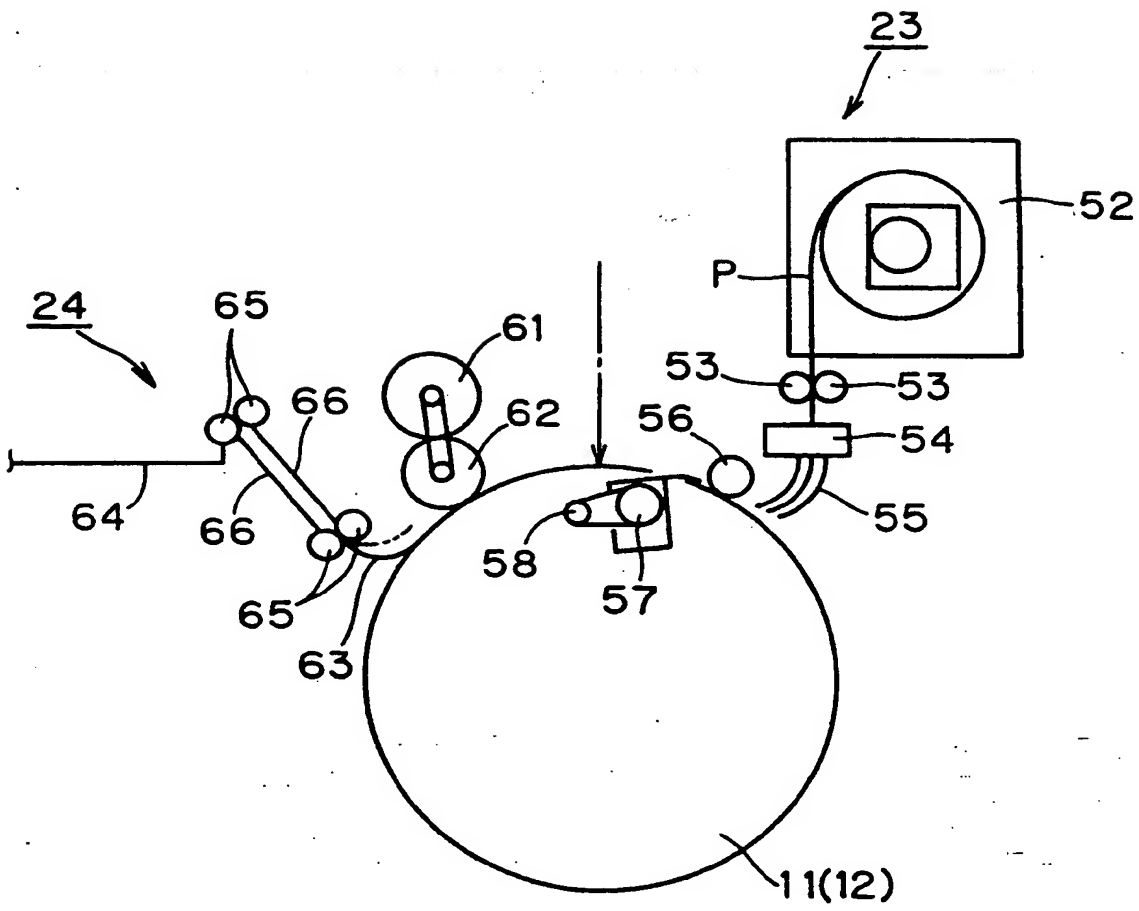


FIG.6A

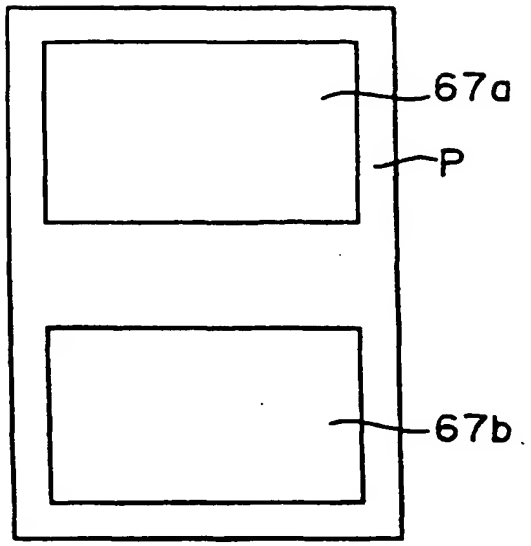


FIG.6B

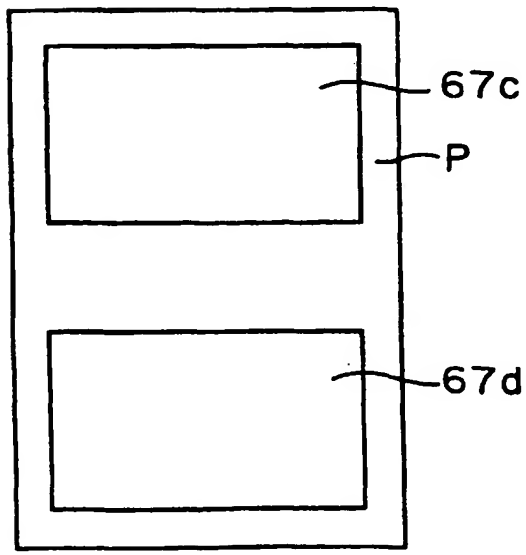


FIG. 7

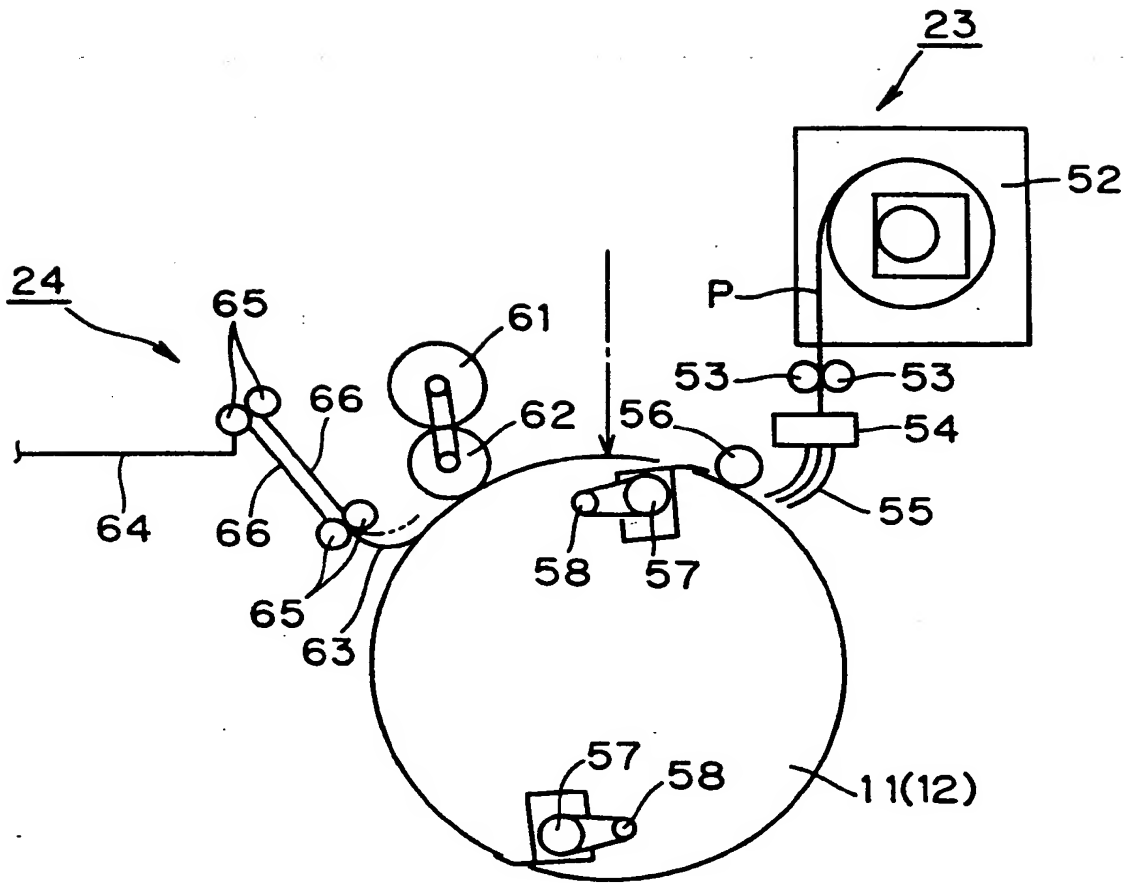


FIG.8

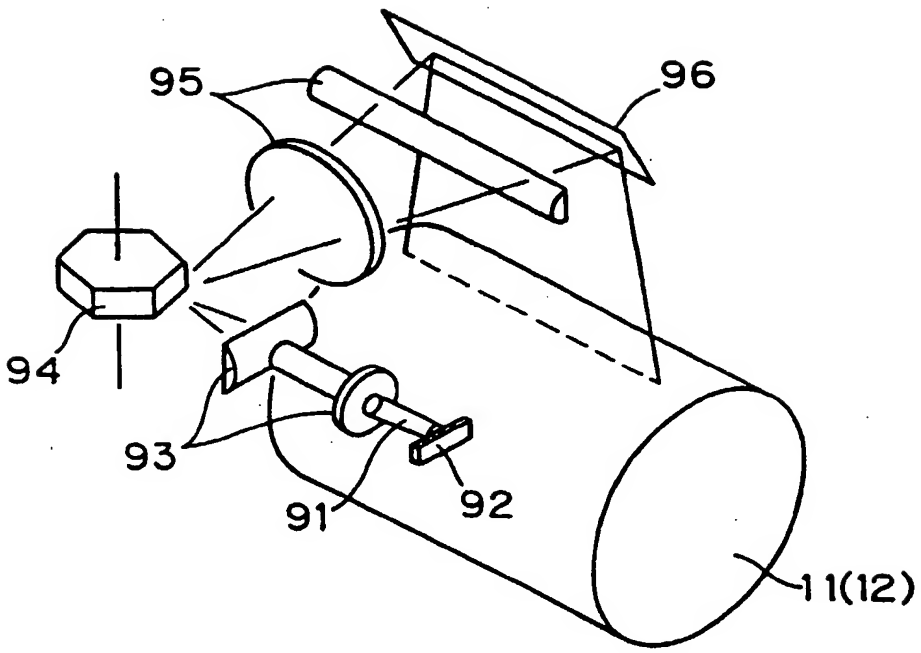


FIG.9

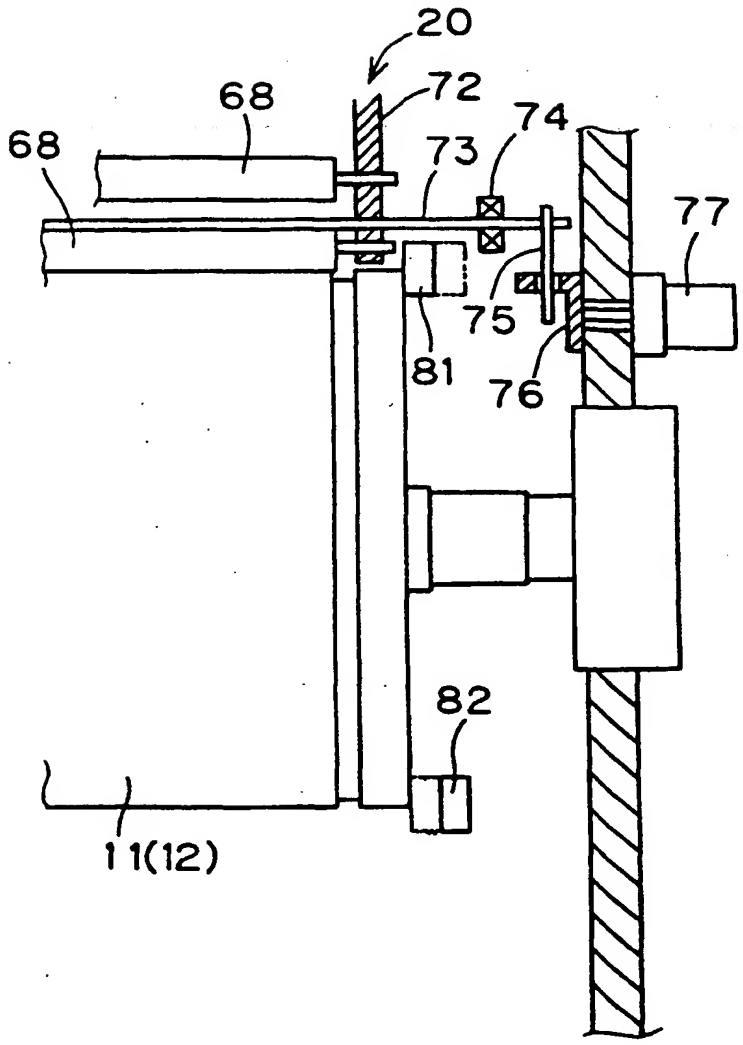
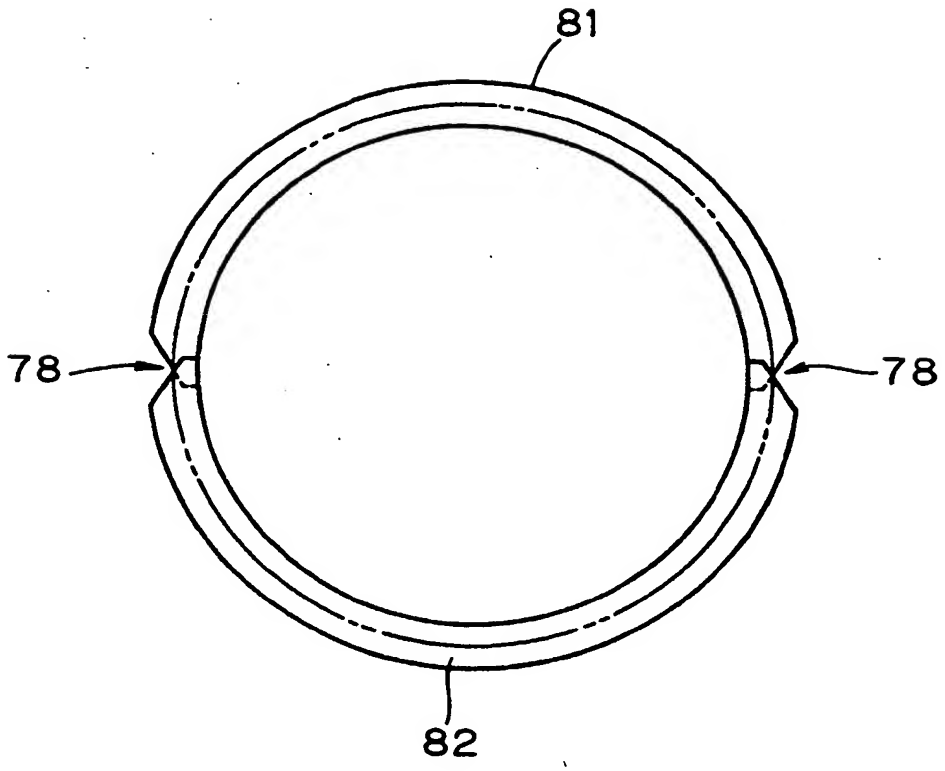


FIG.10



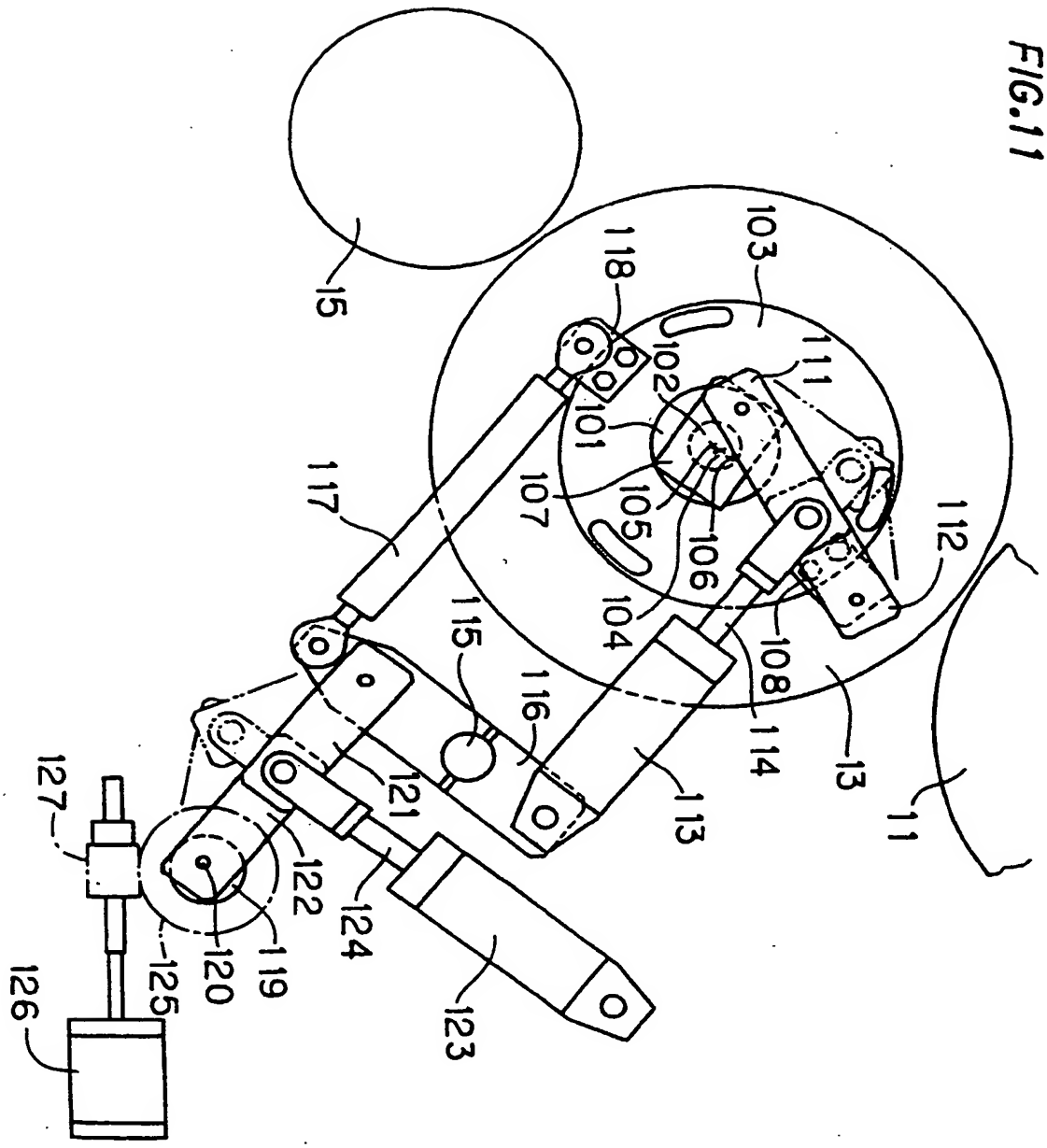


FIG.11

FIG.12

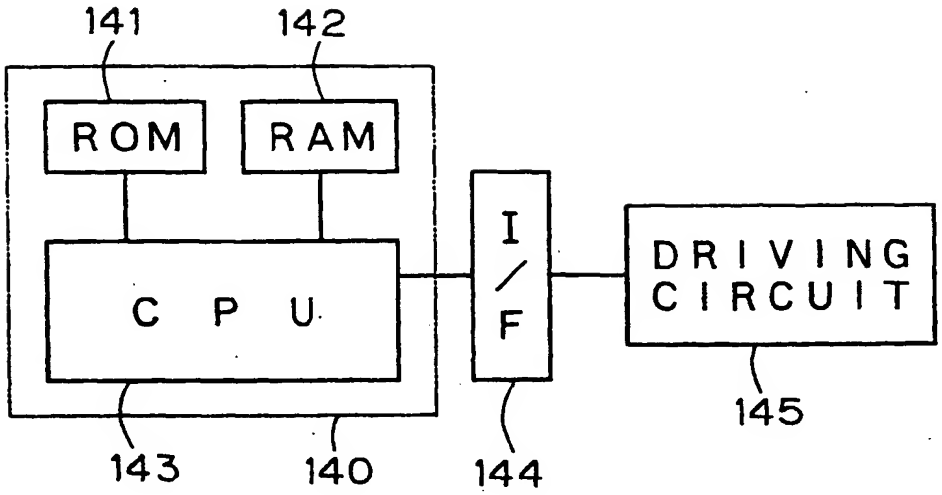


FIG.13

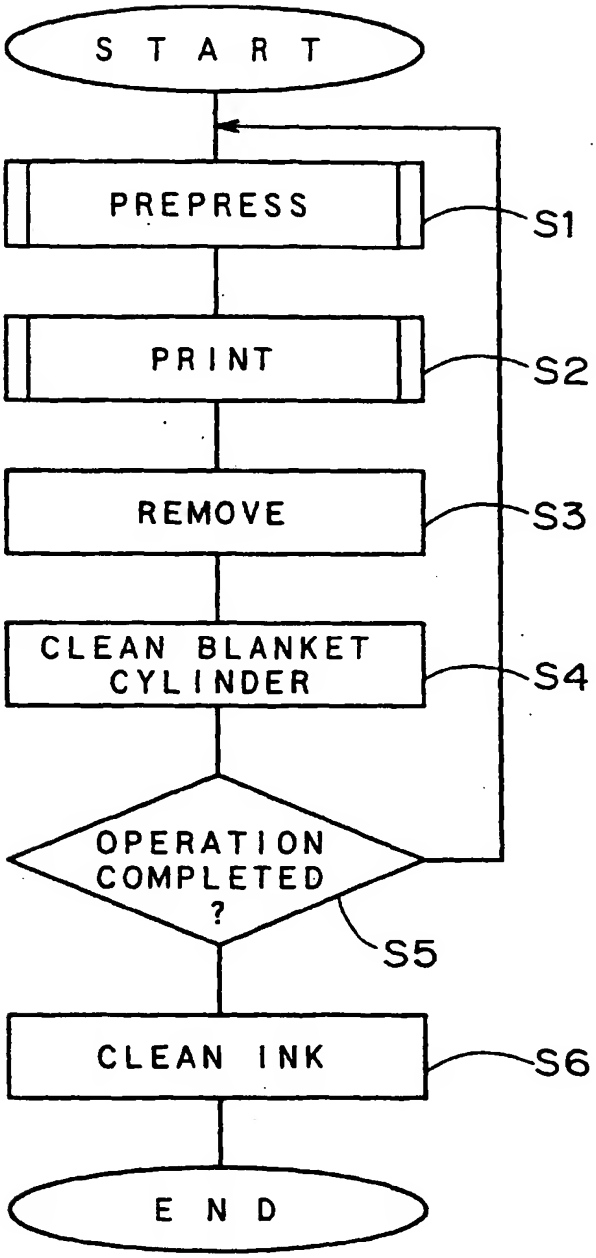


FIG. 14

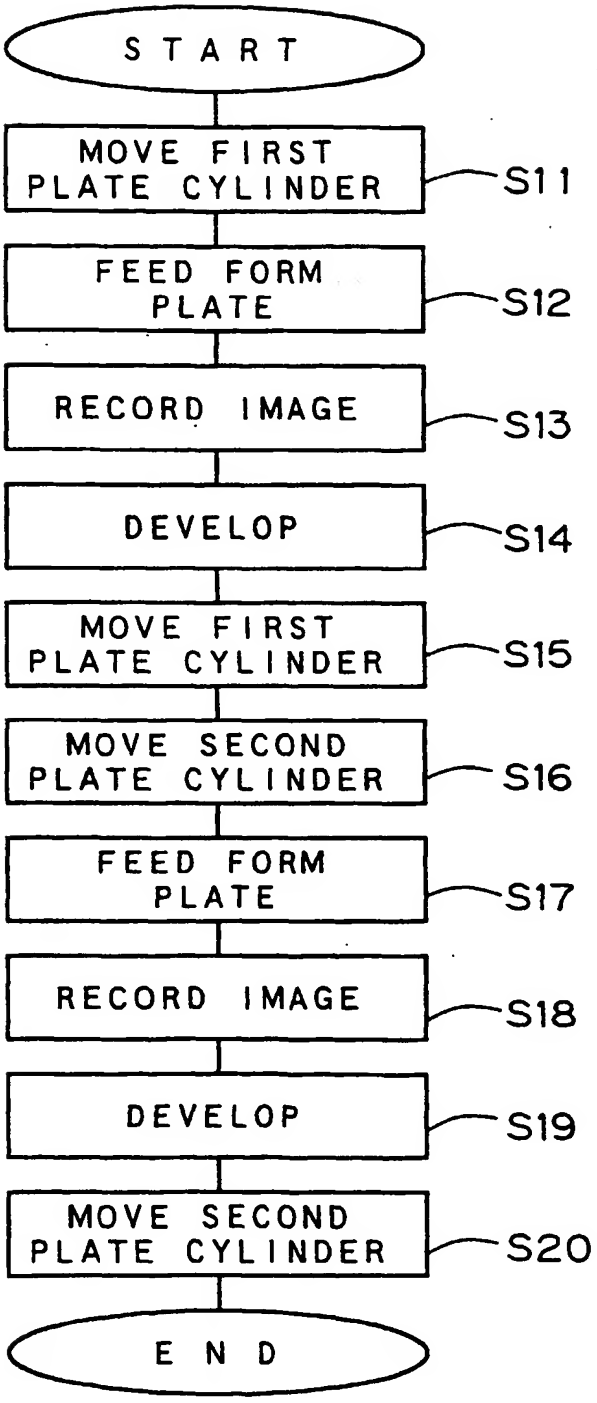


FIG.15A

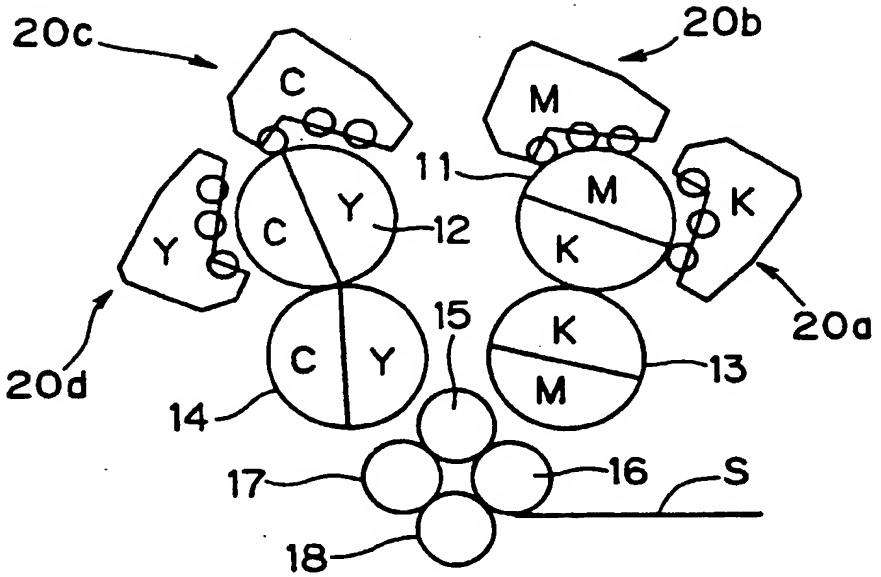


FIG.15B

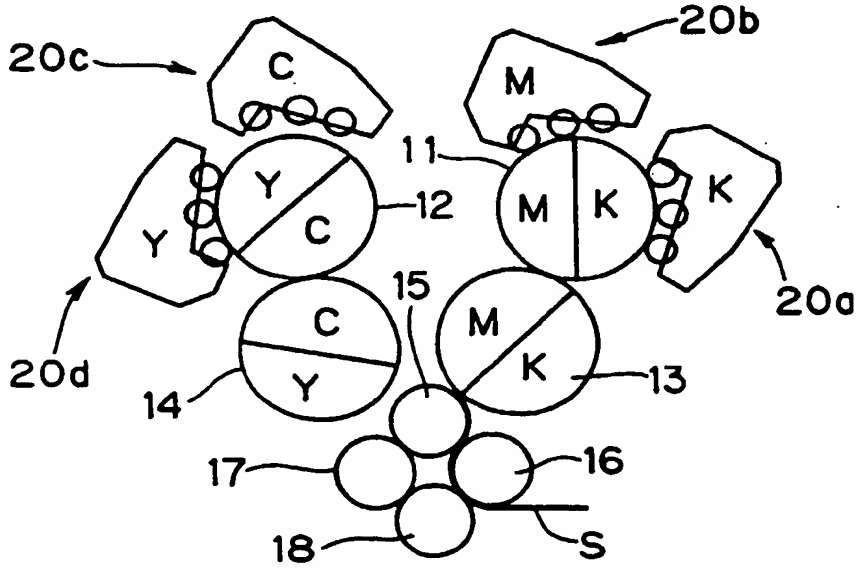


FIG.16A

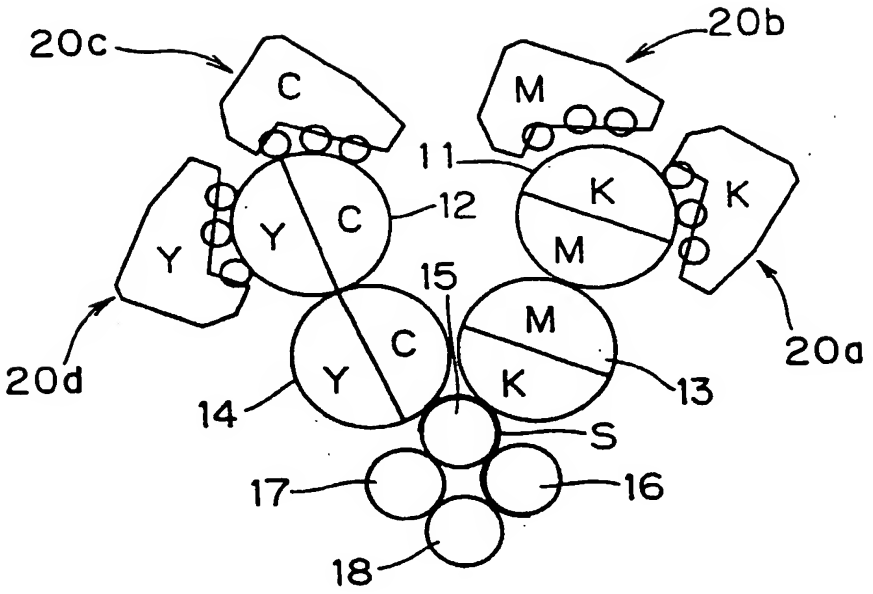


FIG.16B

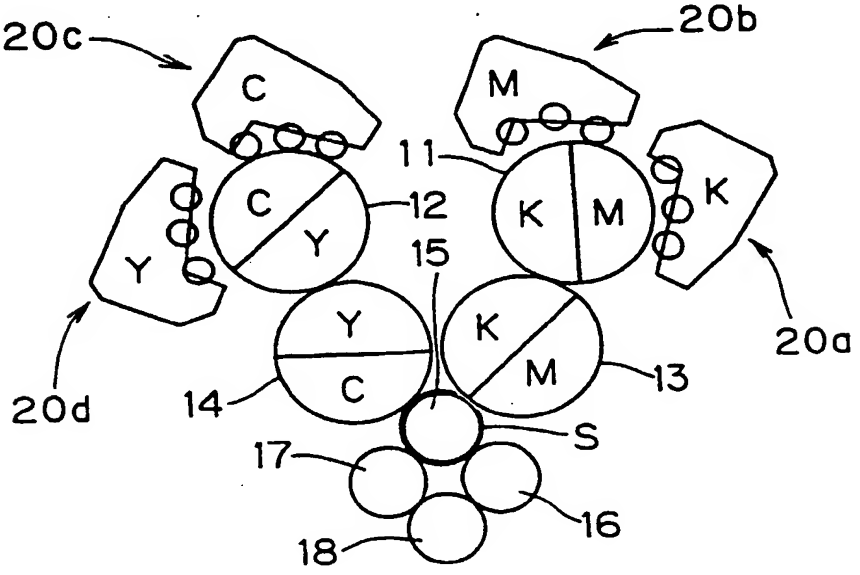


FIG.17A

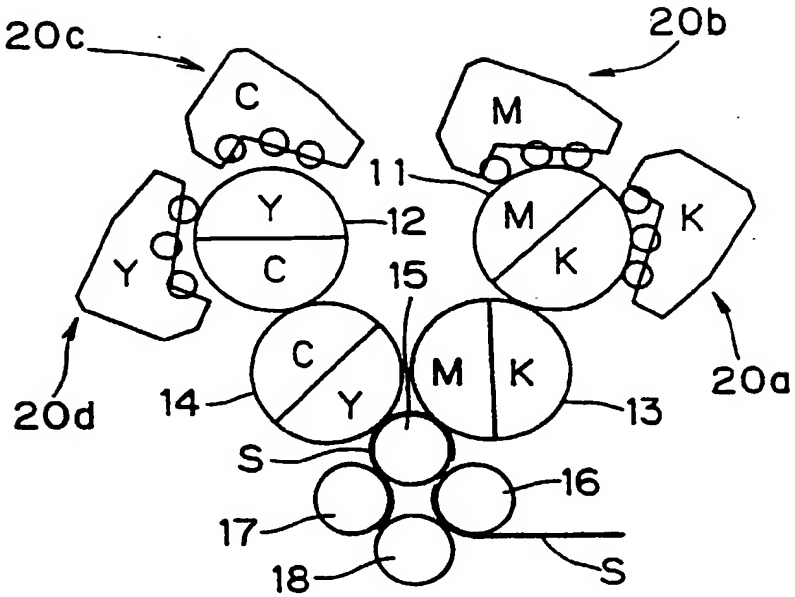


FIG.17B

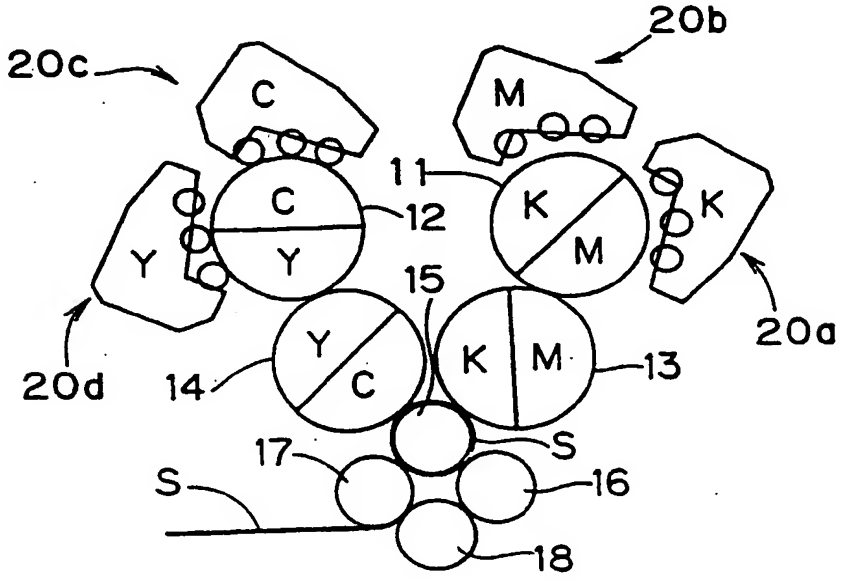


FIG.18

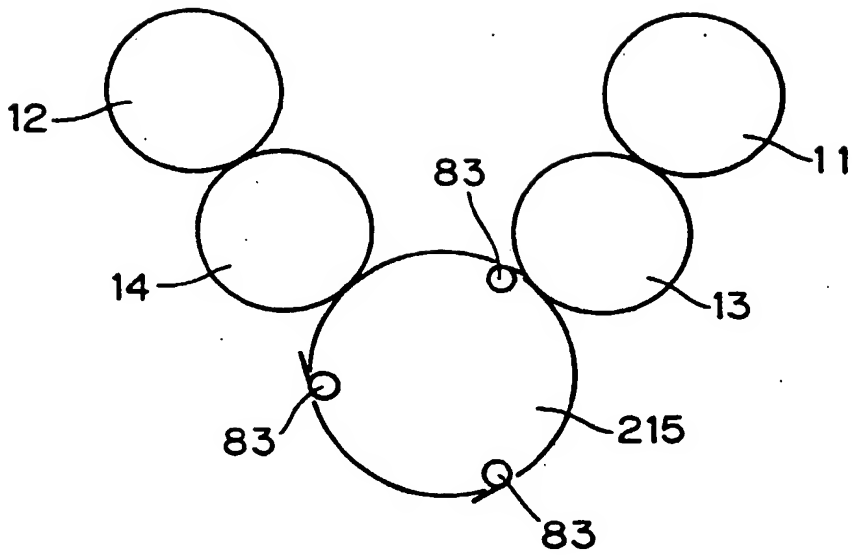
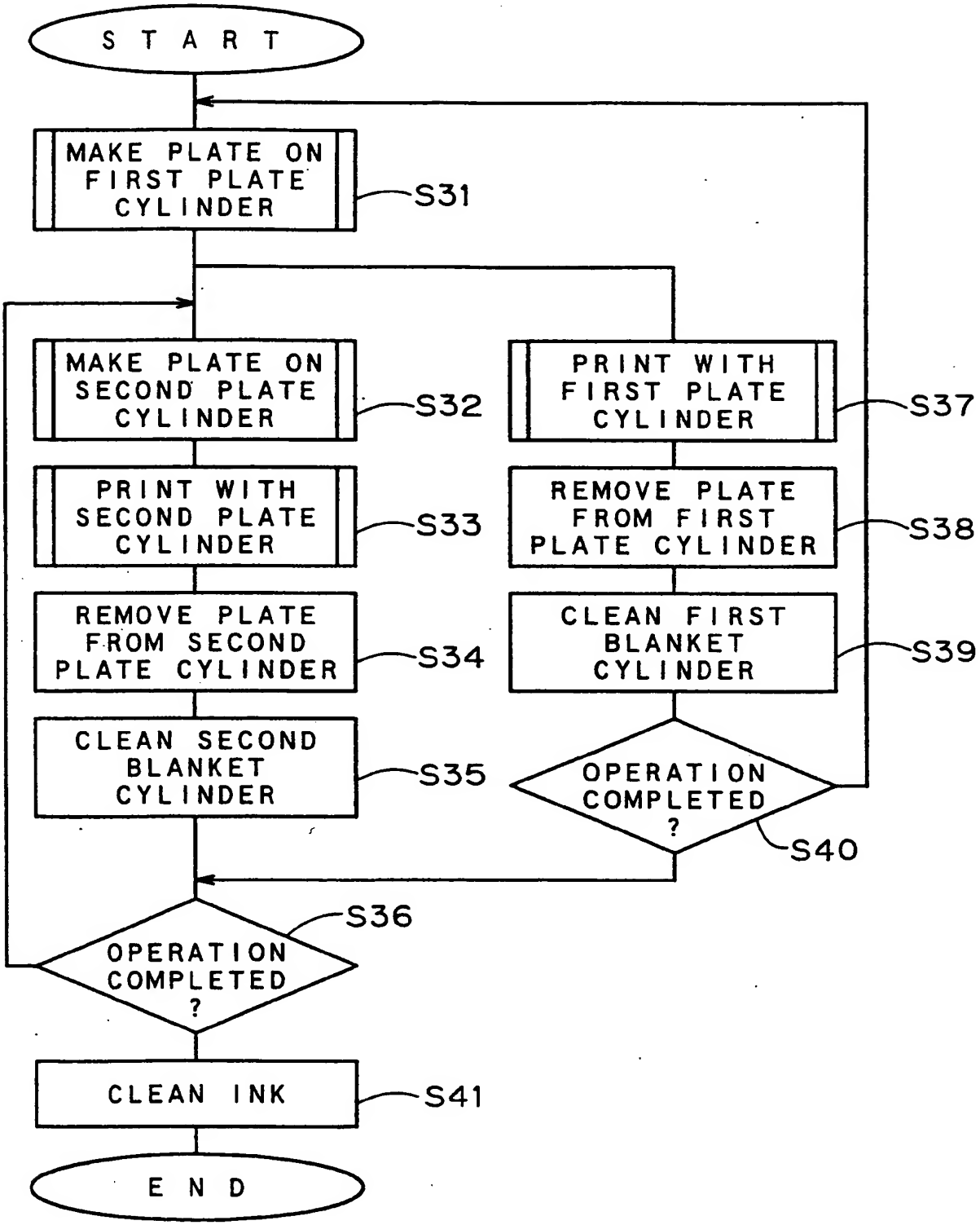


FIG.19



European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 98 10 5664

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	EP 0 639 452 A (ROLAND MAN DRUCKMASCH) 22 February 1995 * figures 1-6,9,13-15 *	1,3,12	B41F7/02
A	DE 33 13 219 A (METRONIC GERAETEBAU) 18 October 1984 * figures *	1,3,12	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

B41F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	13 July 1998	Madsen, P

CATEGORY OF CITED DOCUMENTS

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